US006389625B1

(12) **United States Patent**
Rivera

(10) **Patent No.: US 6,389,625 B1**
(45) **Date of Patent: May 21, 2002**

(54) **MULTIPURPOSE TOOL INCLUDING FOLDING SCISSORS**

(75) Inventor: **Benjamin C. Rivera**, West Linn, OR (US)

(73) Assignee: **Leatherman Tool Group, Inc.**, Portland, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/632,630**

(22) Filed: **Aug. 4, 2000**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/479,411, filed on Jan. 12, 2000.

(51) **Int. Cl.**[7] **B25B 7/22**
(52) **U.S. Cl.** **7/128**; 7/131; 7/135
(58) **Field of Search** 7/128, 131, 135

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Kershaw, small pocket knife with scissors, on sale prior to Jan. 12, 1999 SOG "PowerLock"™ tool Model S–60.
SOG, PowerLock folding tool model S–60, on sale at least as early as May 1999, instruction sheet and photographs.
Buck Knives, Bucklite multipurpose folding tool, model 355, on sale prior to May 1999, photographs.
Folding scissors marked INOX France, on sale at least as early as 1994, photographs.
Folding scissors with chain, on sale at least as early as 1994, photographs.

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Primary Examiner—Timothy V. Eley
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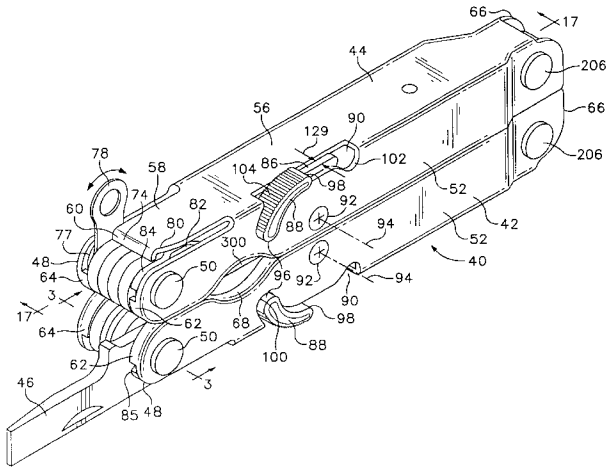
(74) *Attorney, Agent, or Firm*—Chernoff, Vilhauer, McClung & Stenzel, LLP

(57) **ABSTRACT**

A folding multipurpose tool incorporating a latch release mechanism including a lever, a cam, and a rocker-shaped grip body to easily effect release of a catch for holding knife or screwdriver blades extended. A spring and cams are arranged to hold each of a pair of handles either extended or folded with respect to the tangs of a pair of pliers jaws or the like. The handles include inwardly directed comfortable rounded rims. Portions of folding blades interlock with other folding blades on an opposite handle when the tool is folded, to stabilize the handles while using a knife or screwdriver. Blades of folding scissors include edges that are serrated only near their tips. A container opener includes a hook defining a recessed throat.

4 Claims, 24 Drawing Sheets



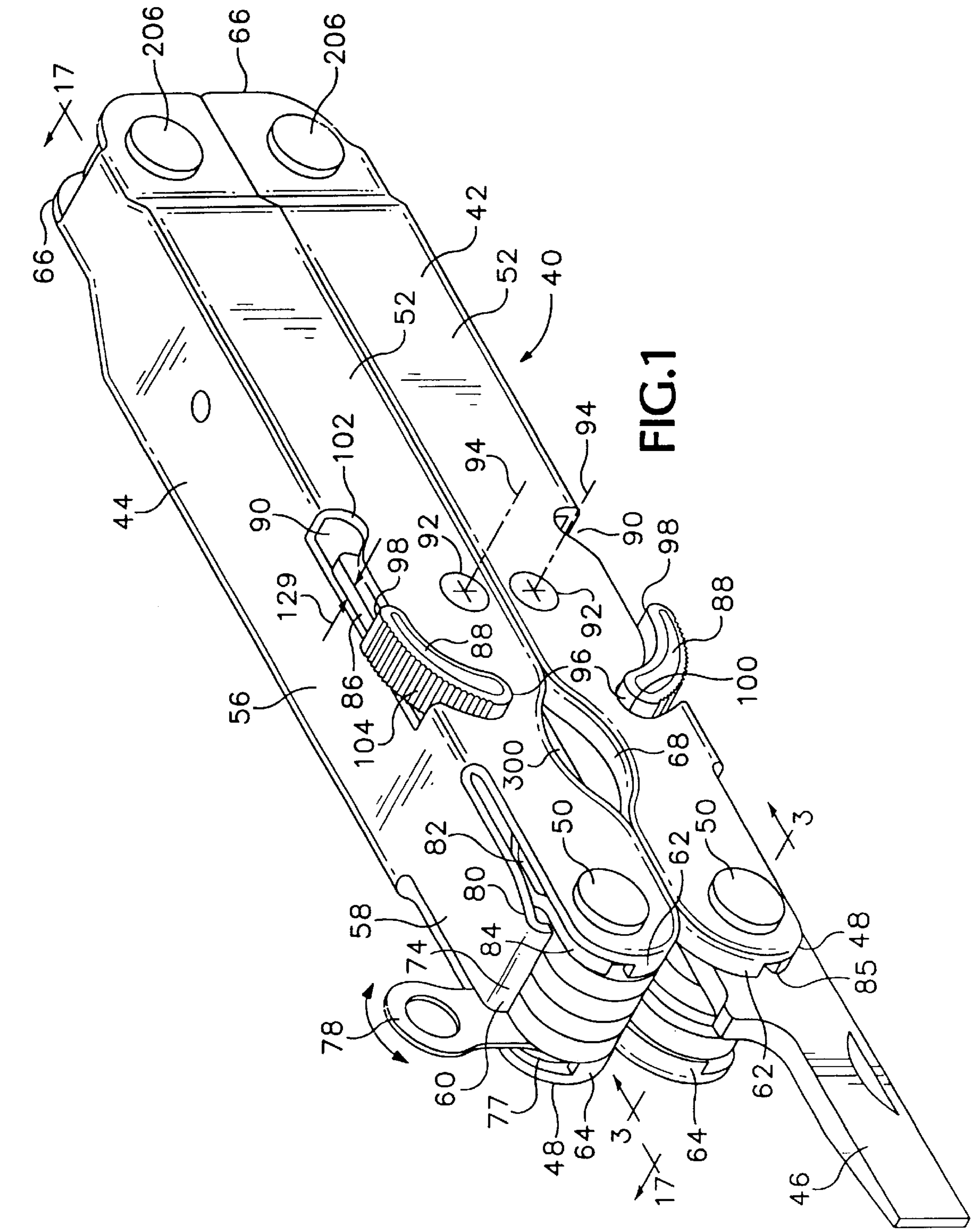

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FIG.1

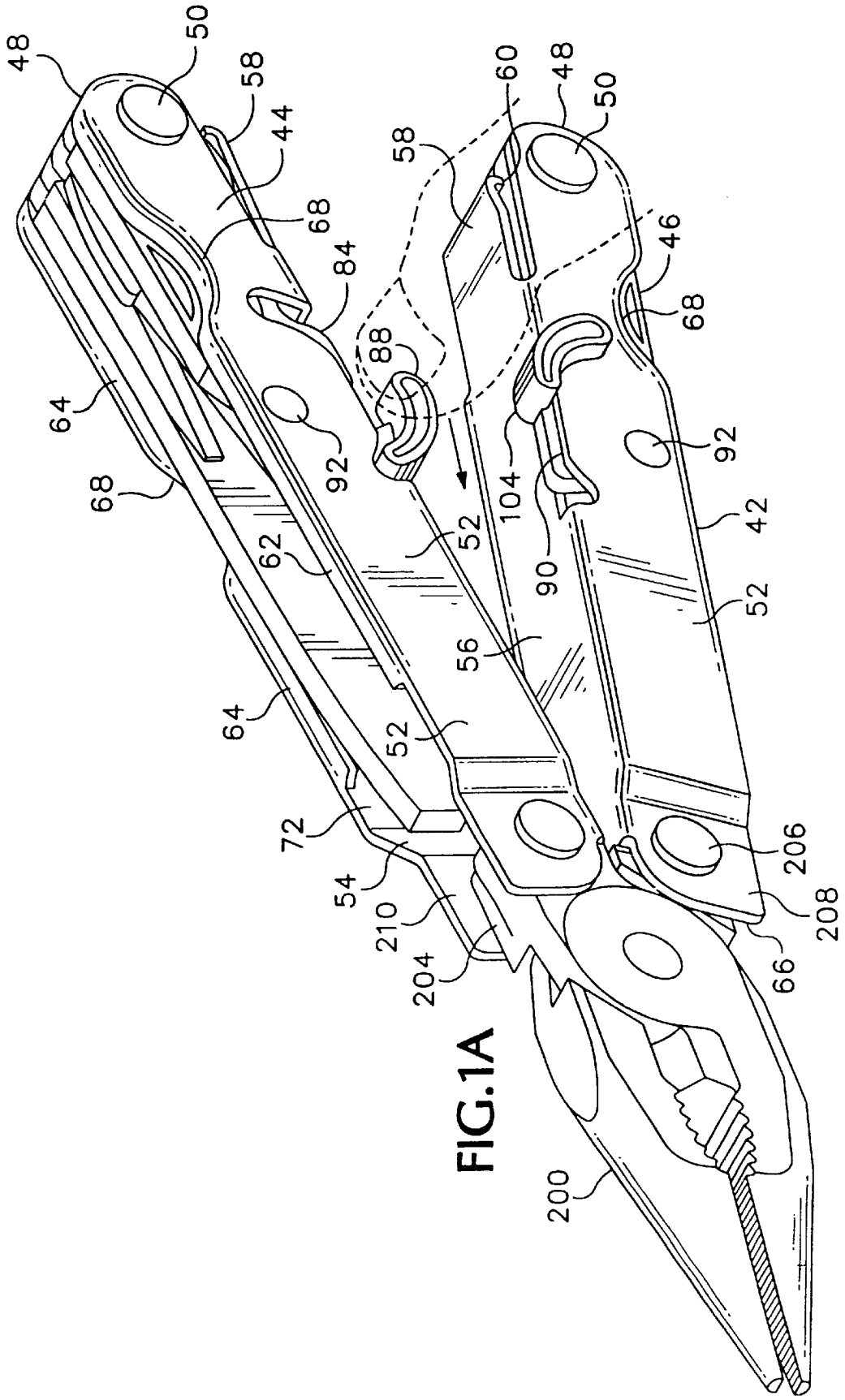
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FIG.1A

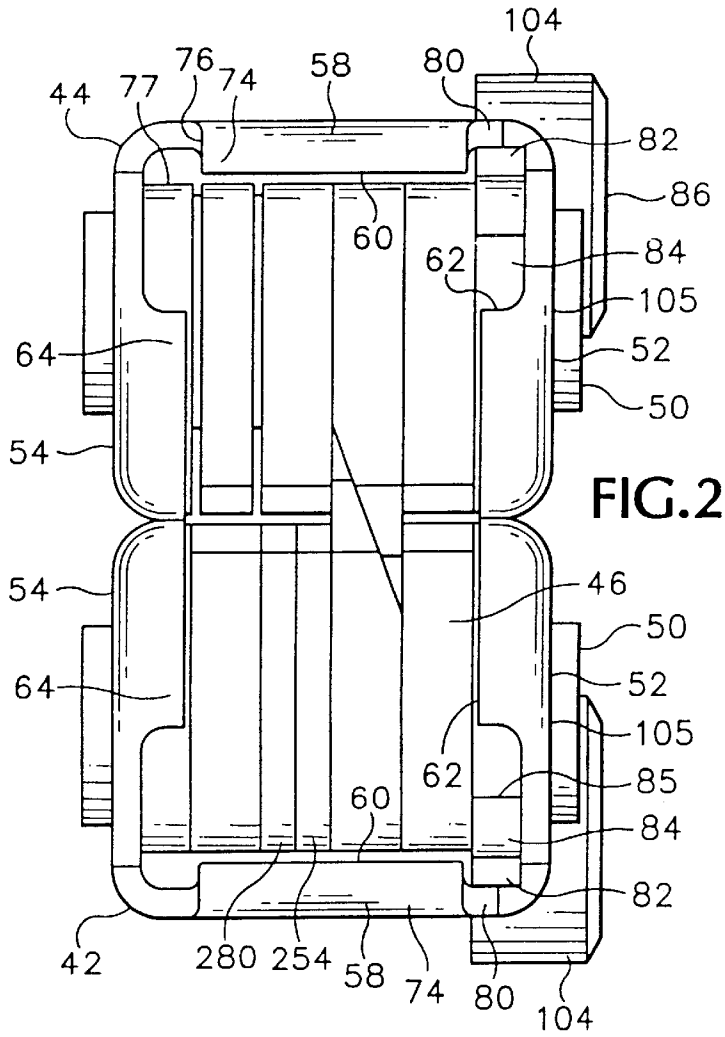
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FIG.2

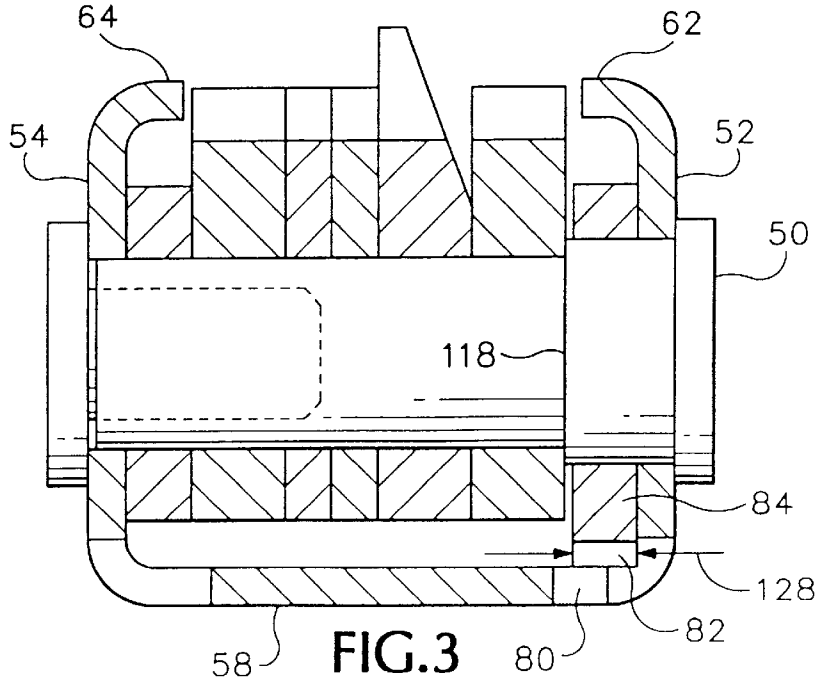
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FIG.3

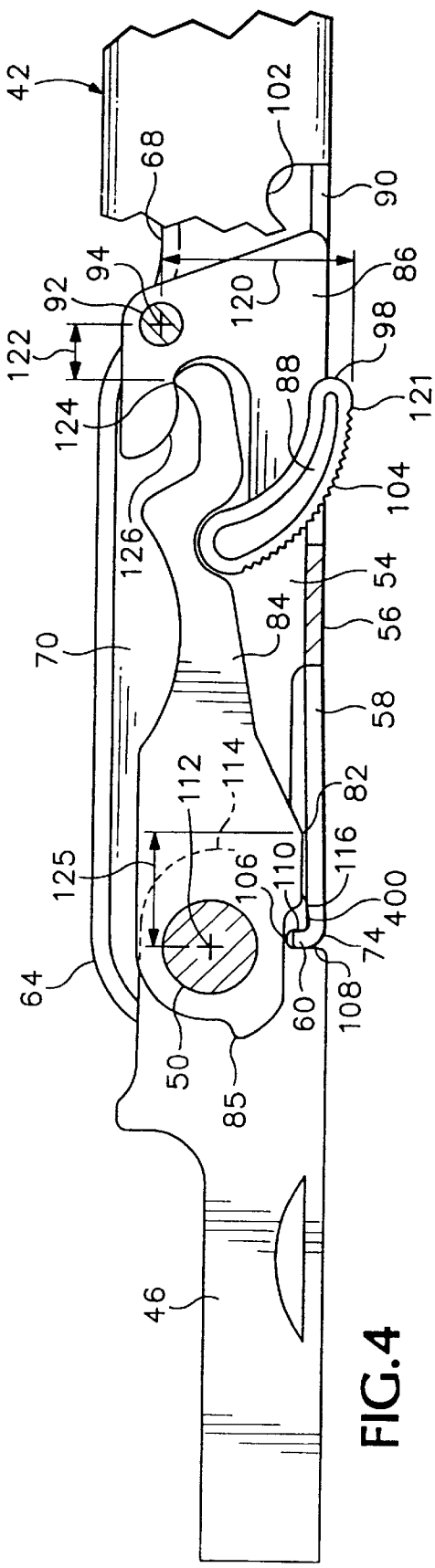
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FIG.4

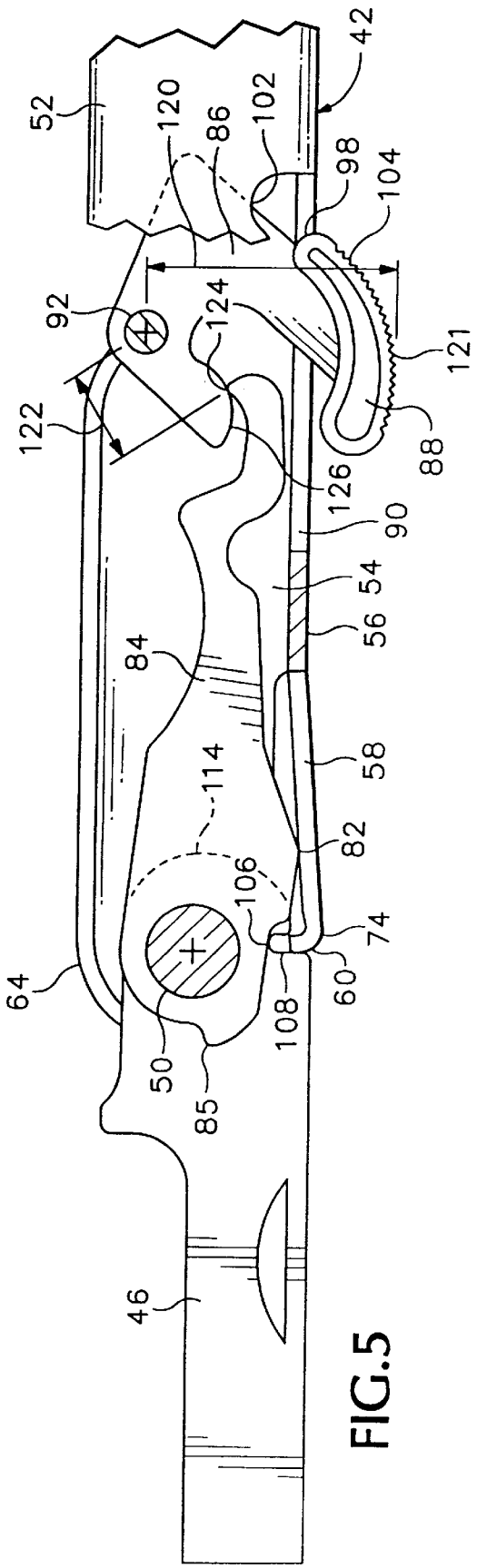
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FIG.5

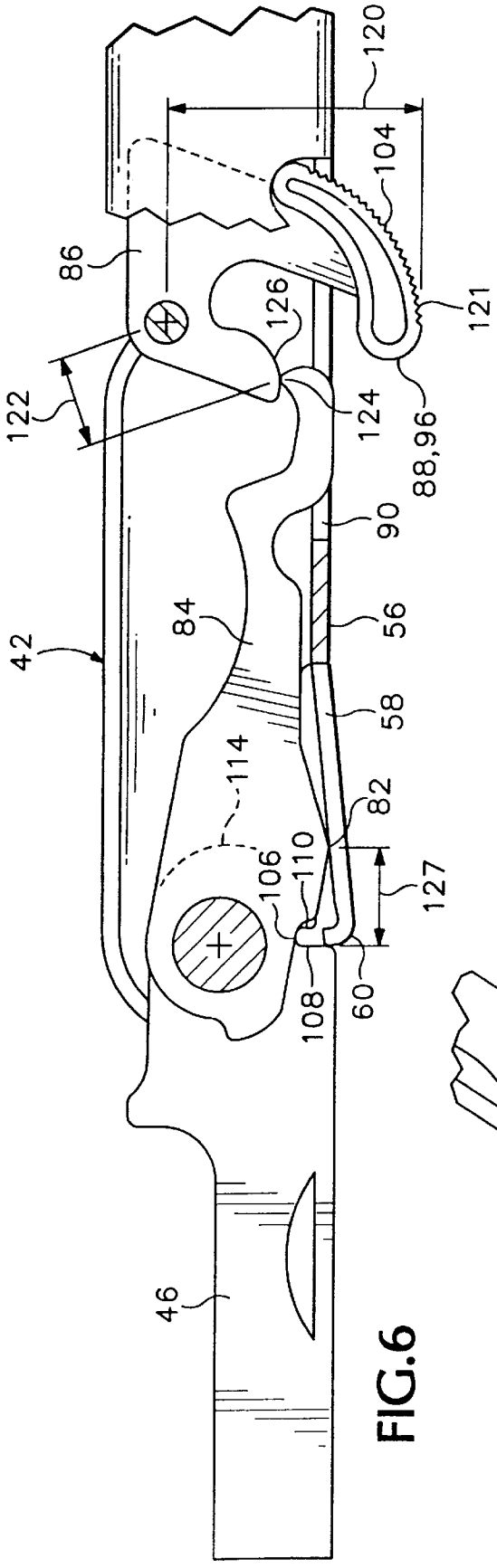
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FIG.6

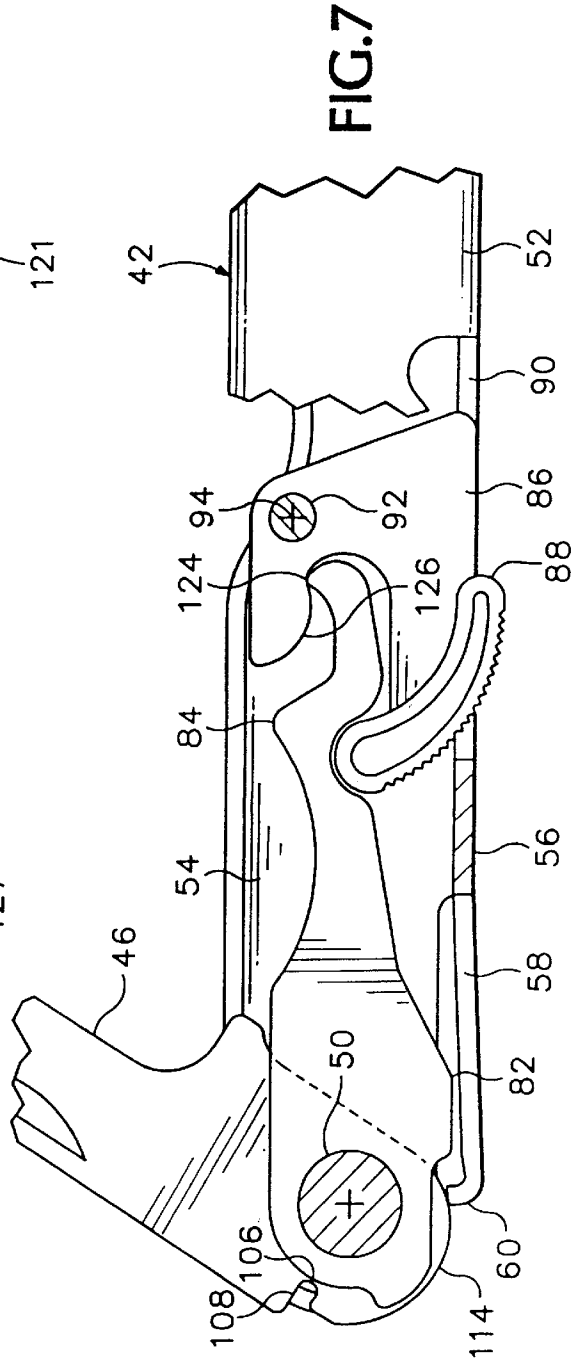
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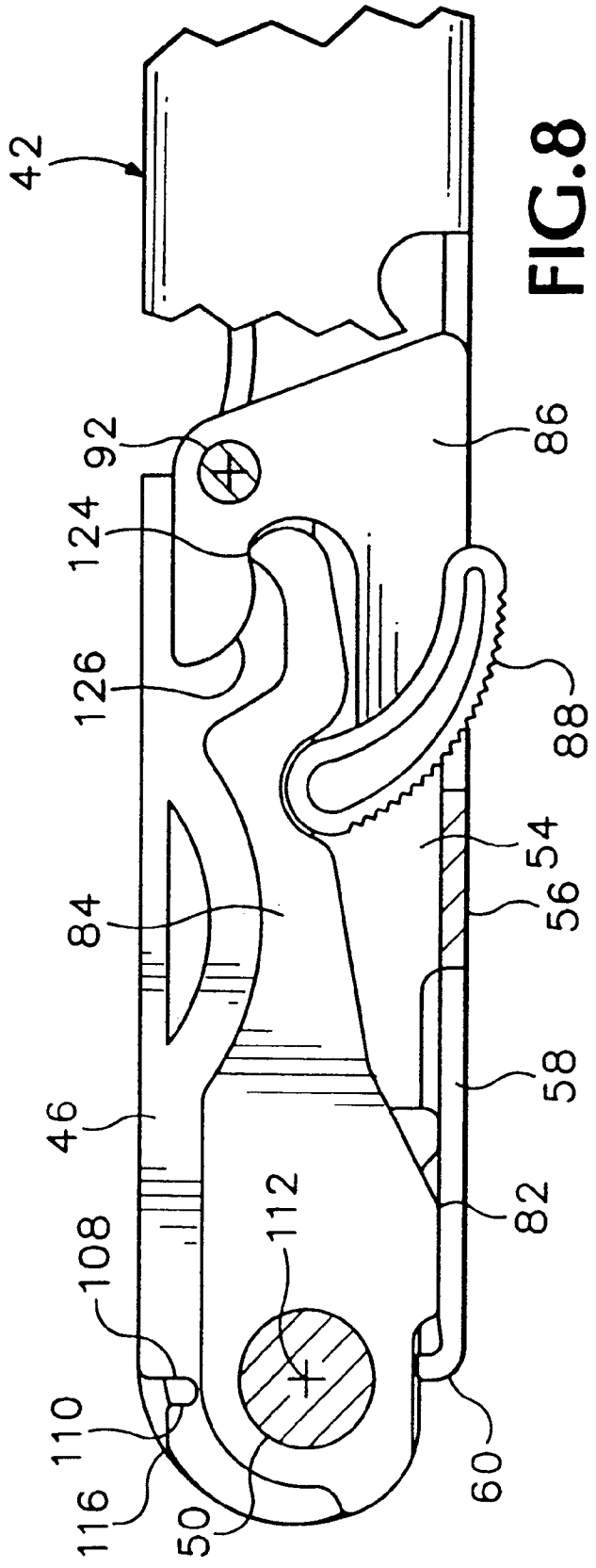
FIG.7



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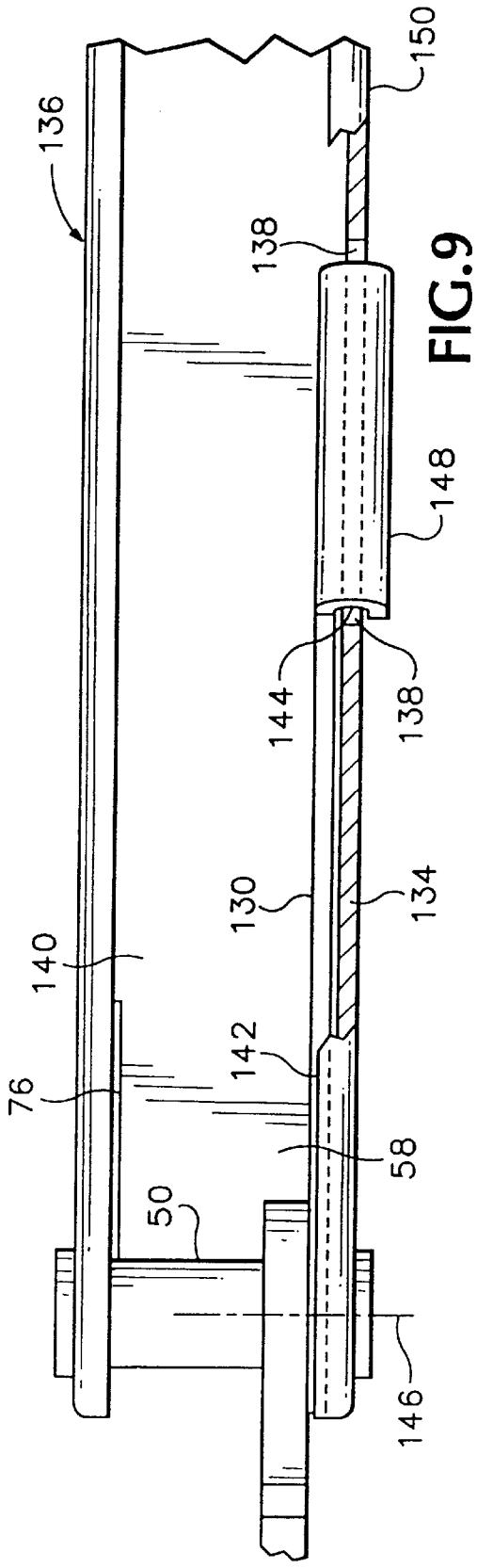
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FIG.9

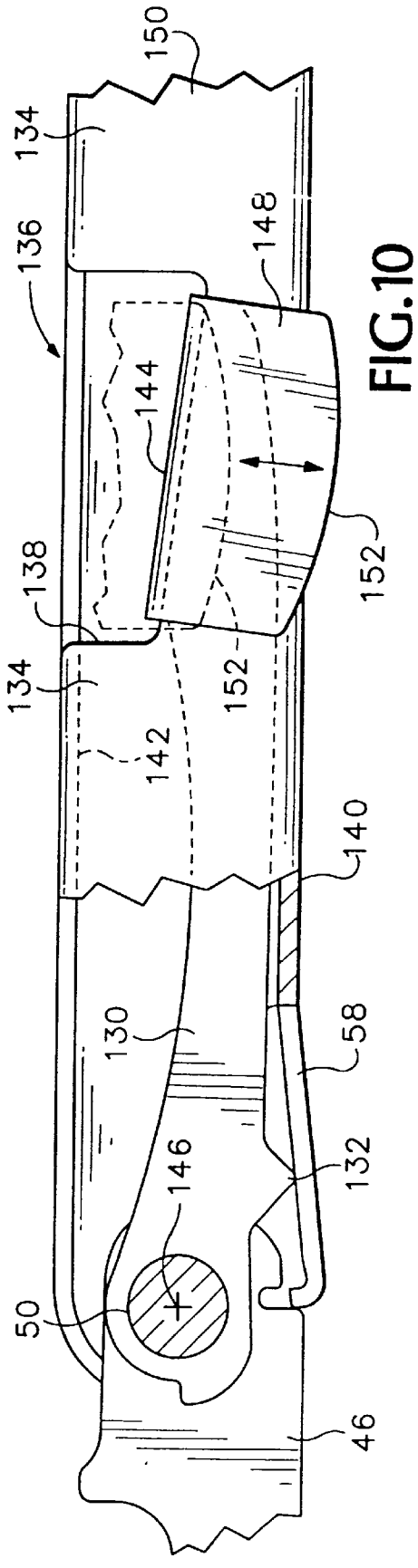
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FIG.10

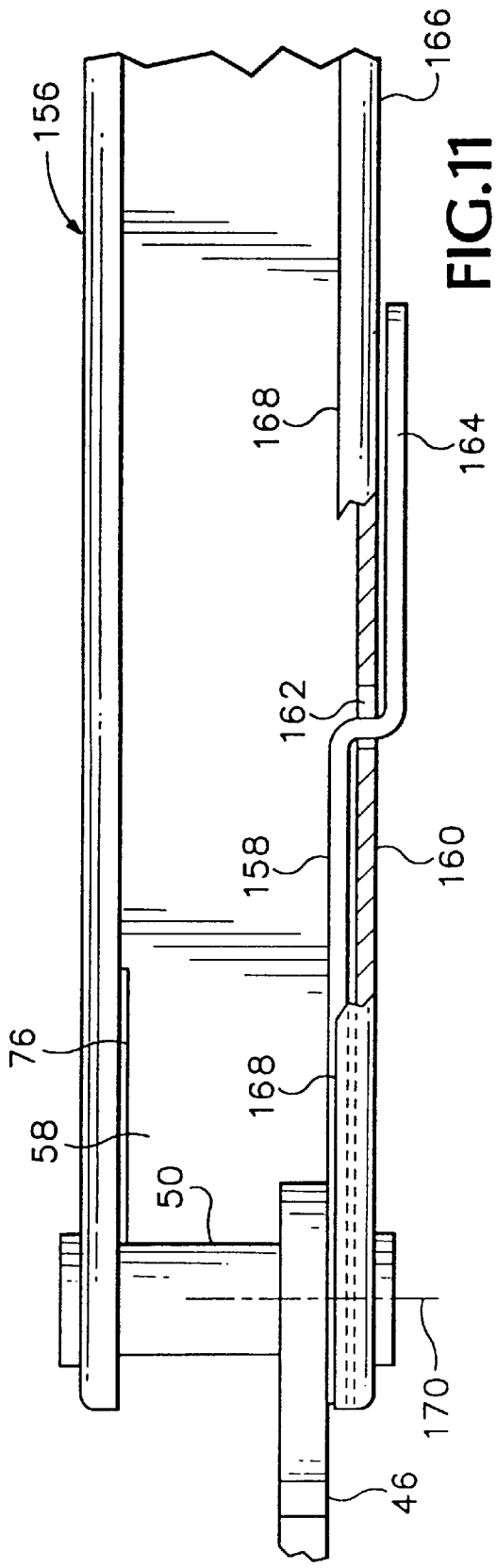
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FIG.11

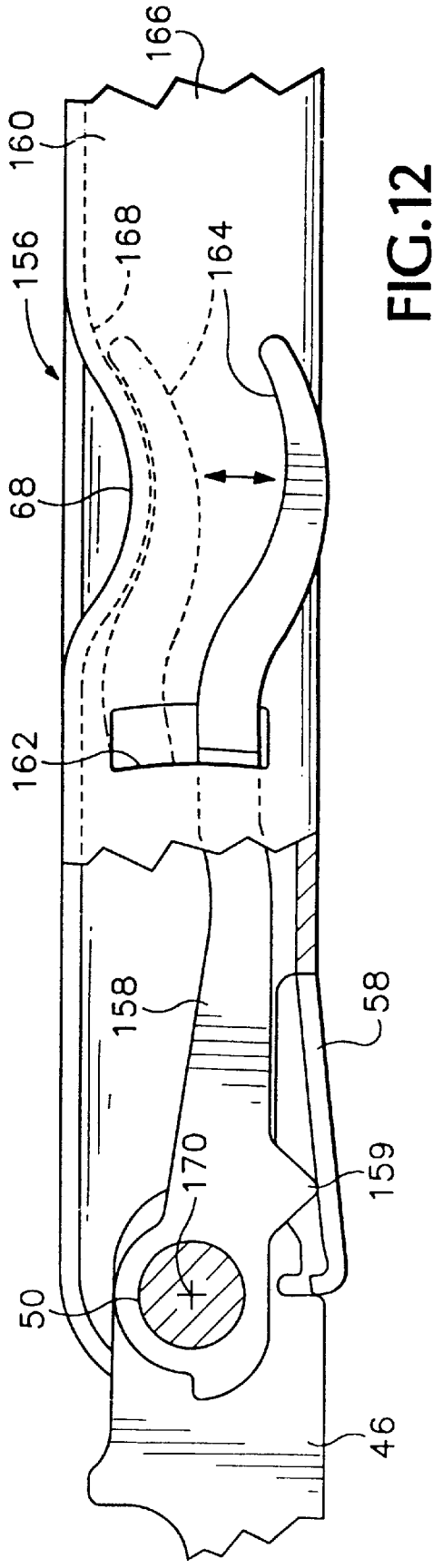
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FIG.12

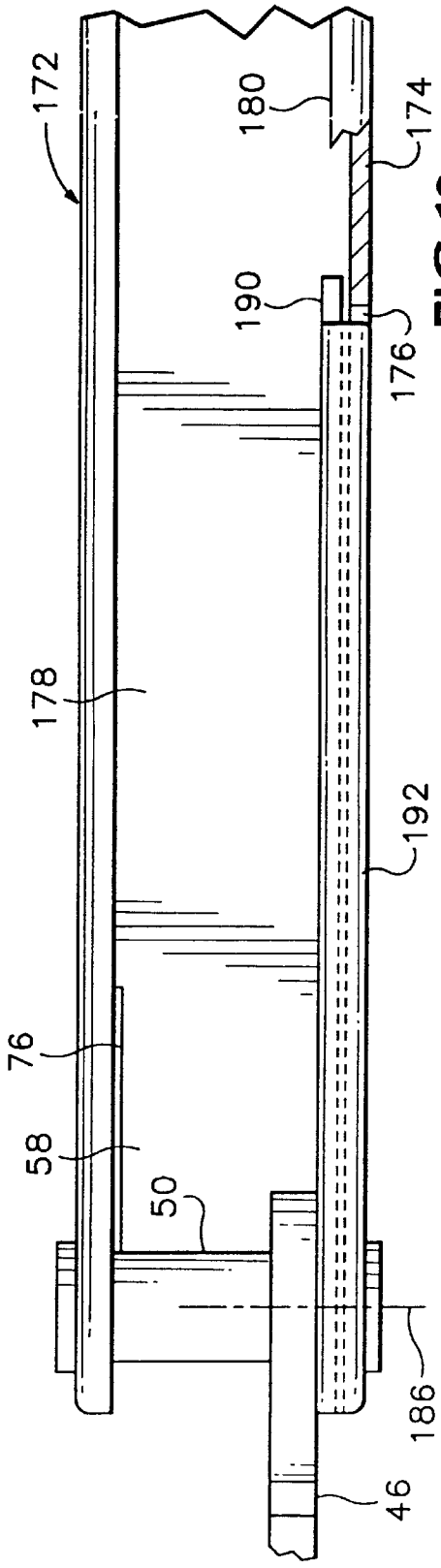
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FIG.13

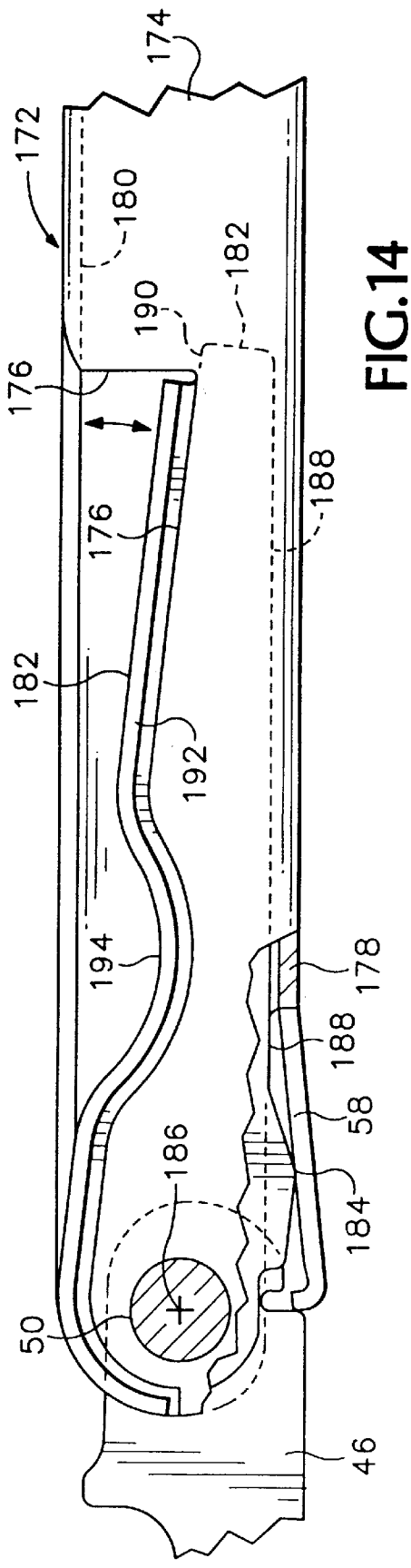
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FIG.14

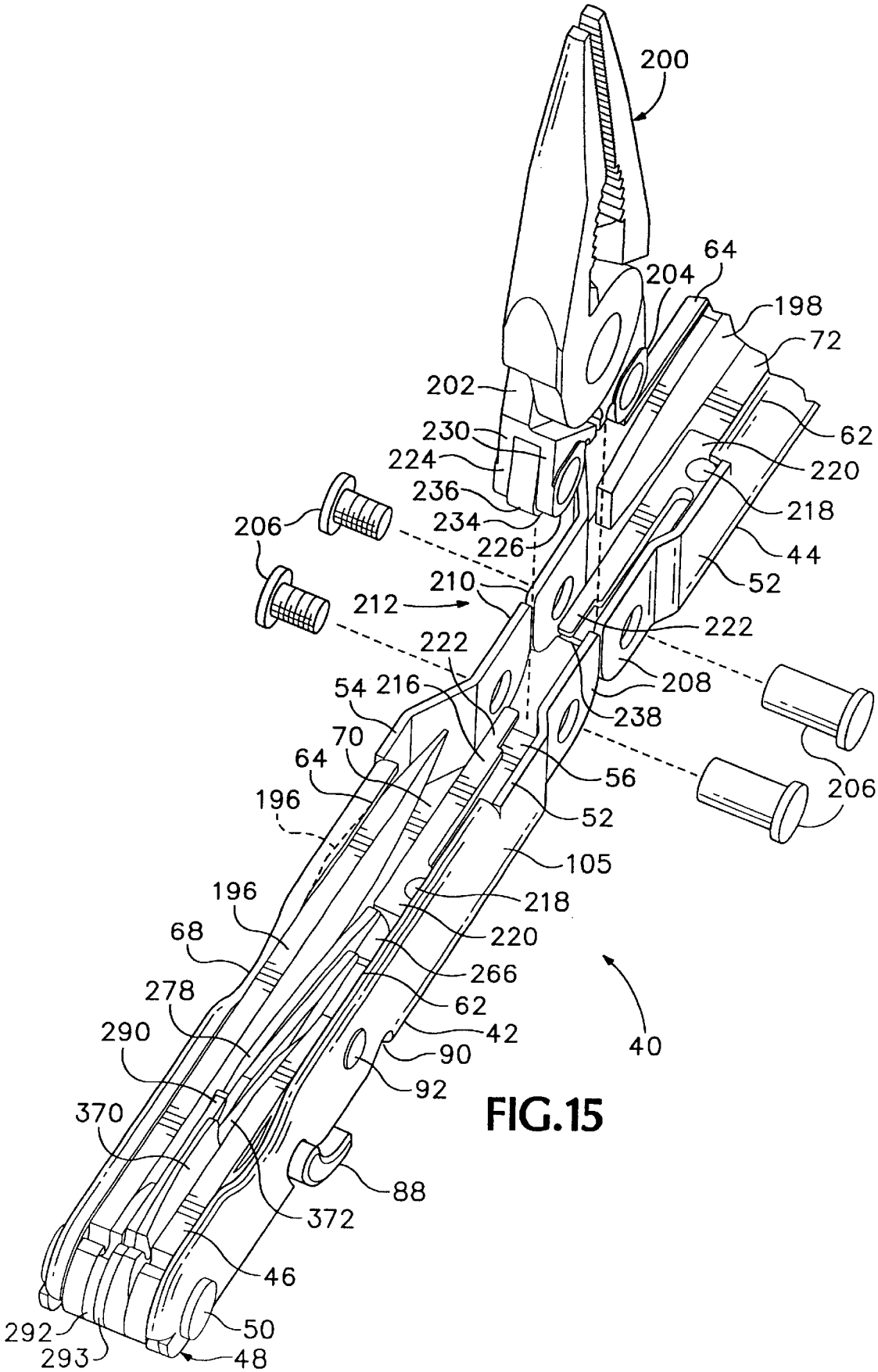
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FIG.15

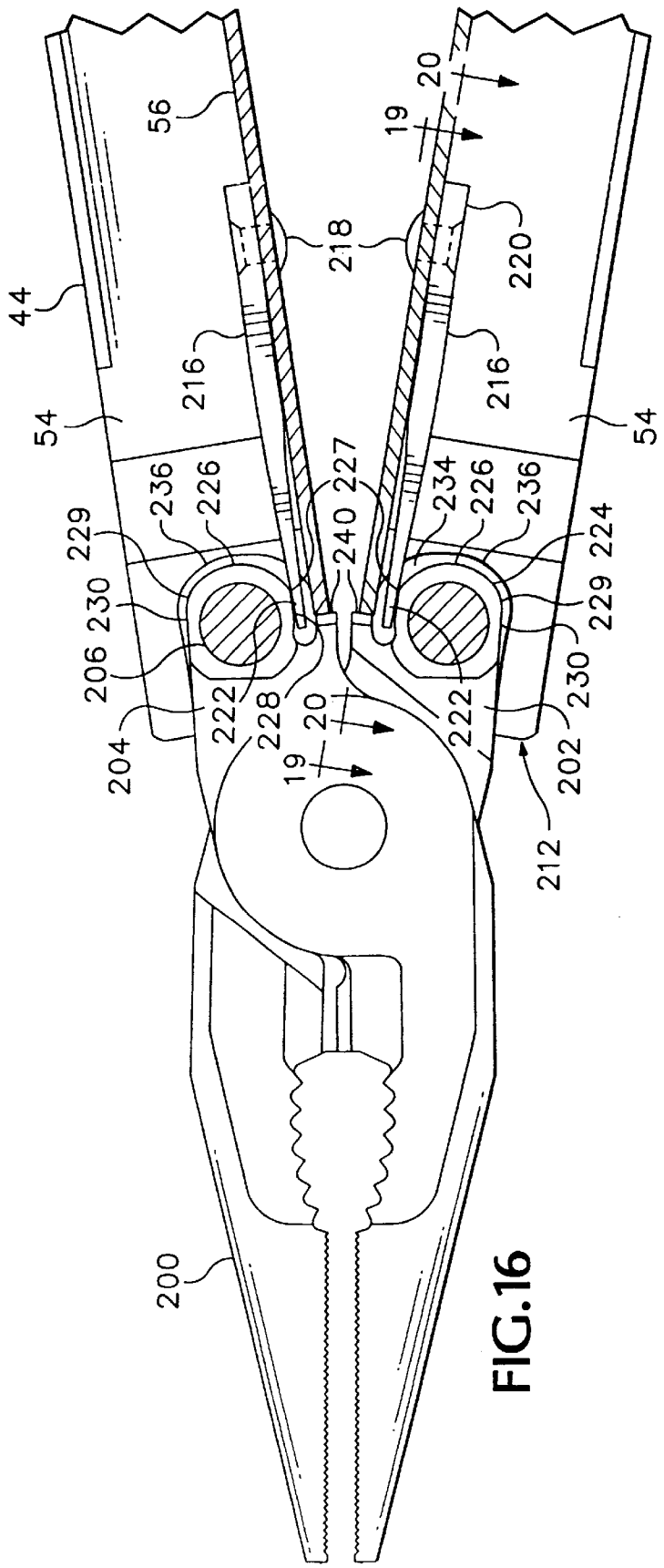
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FIG.16

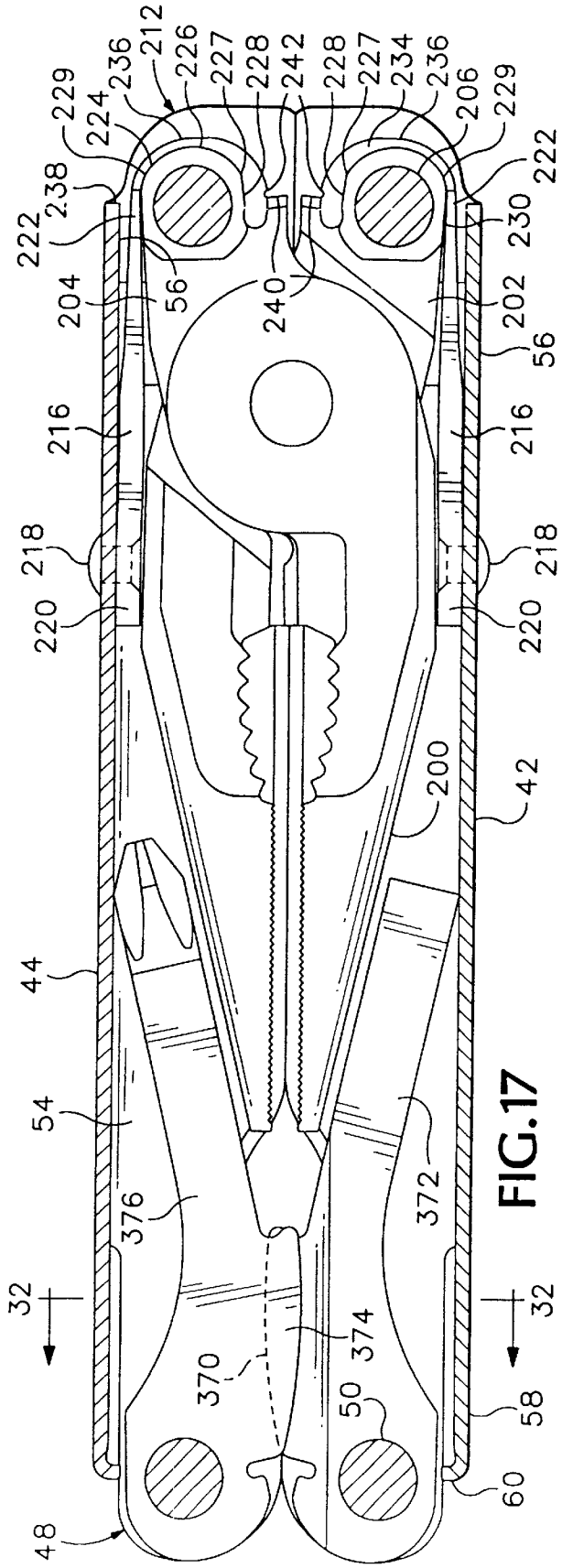
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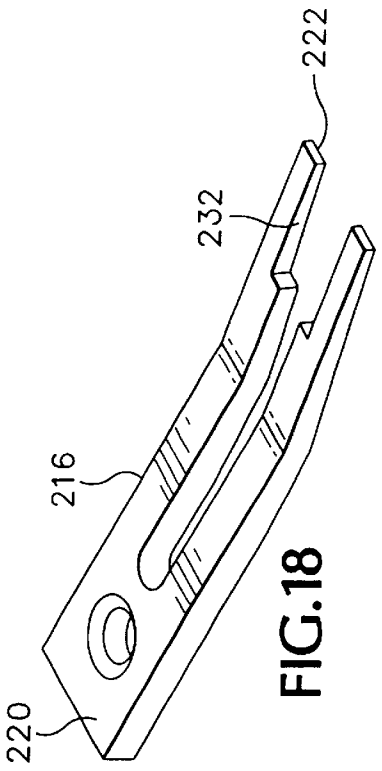
FIG.17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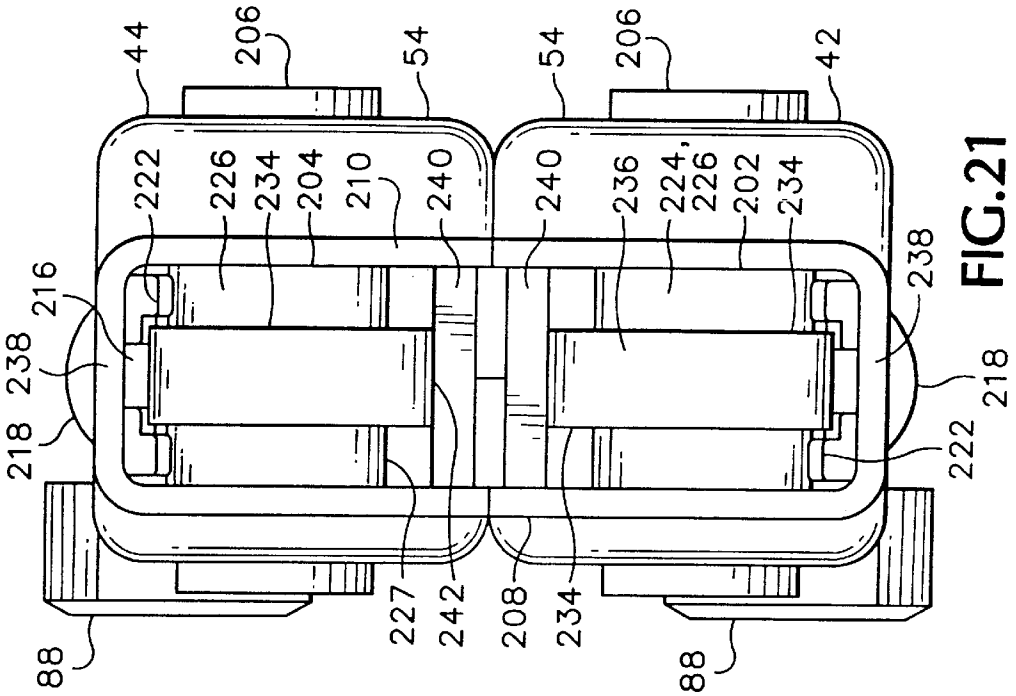
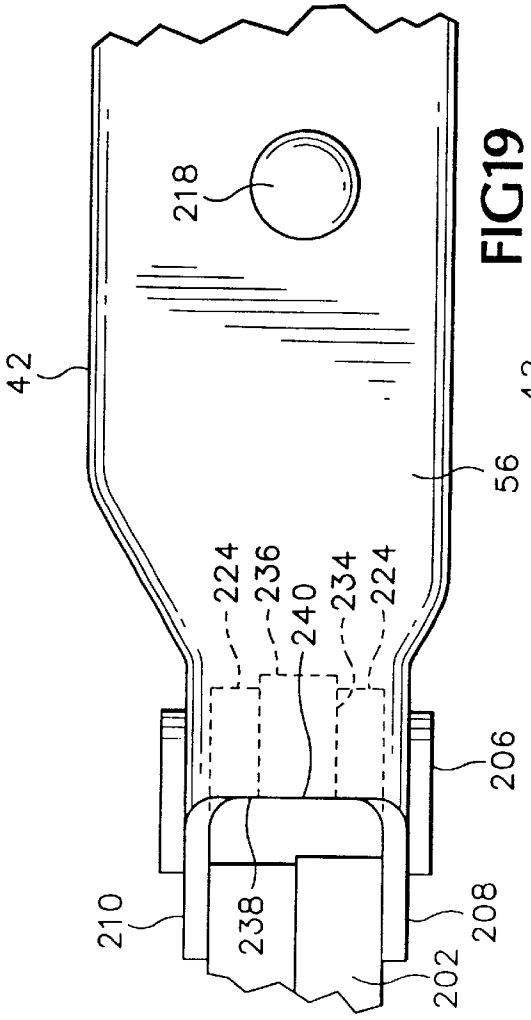


FIG.21



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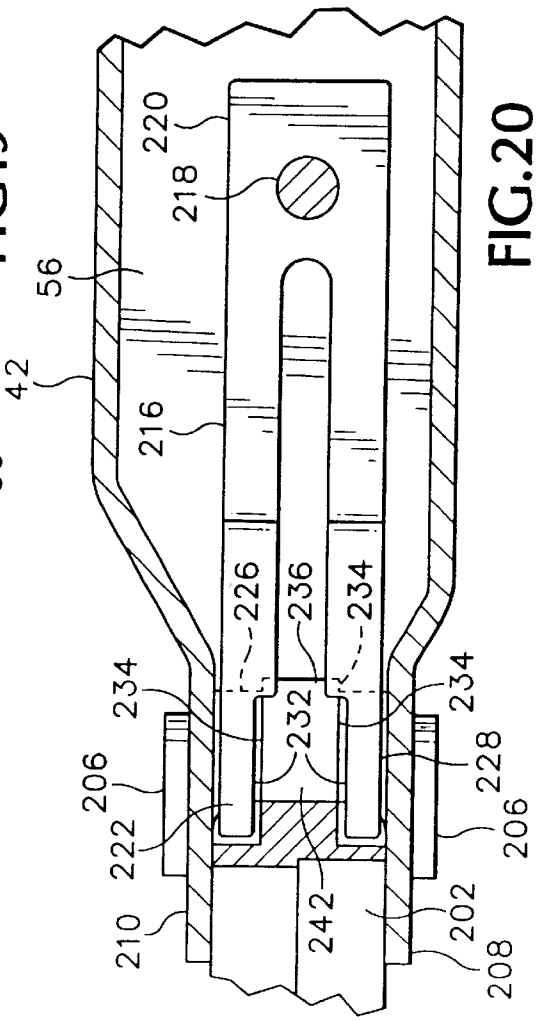

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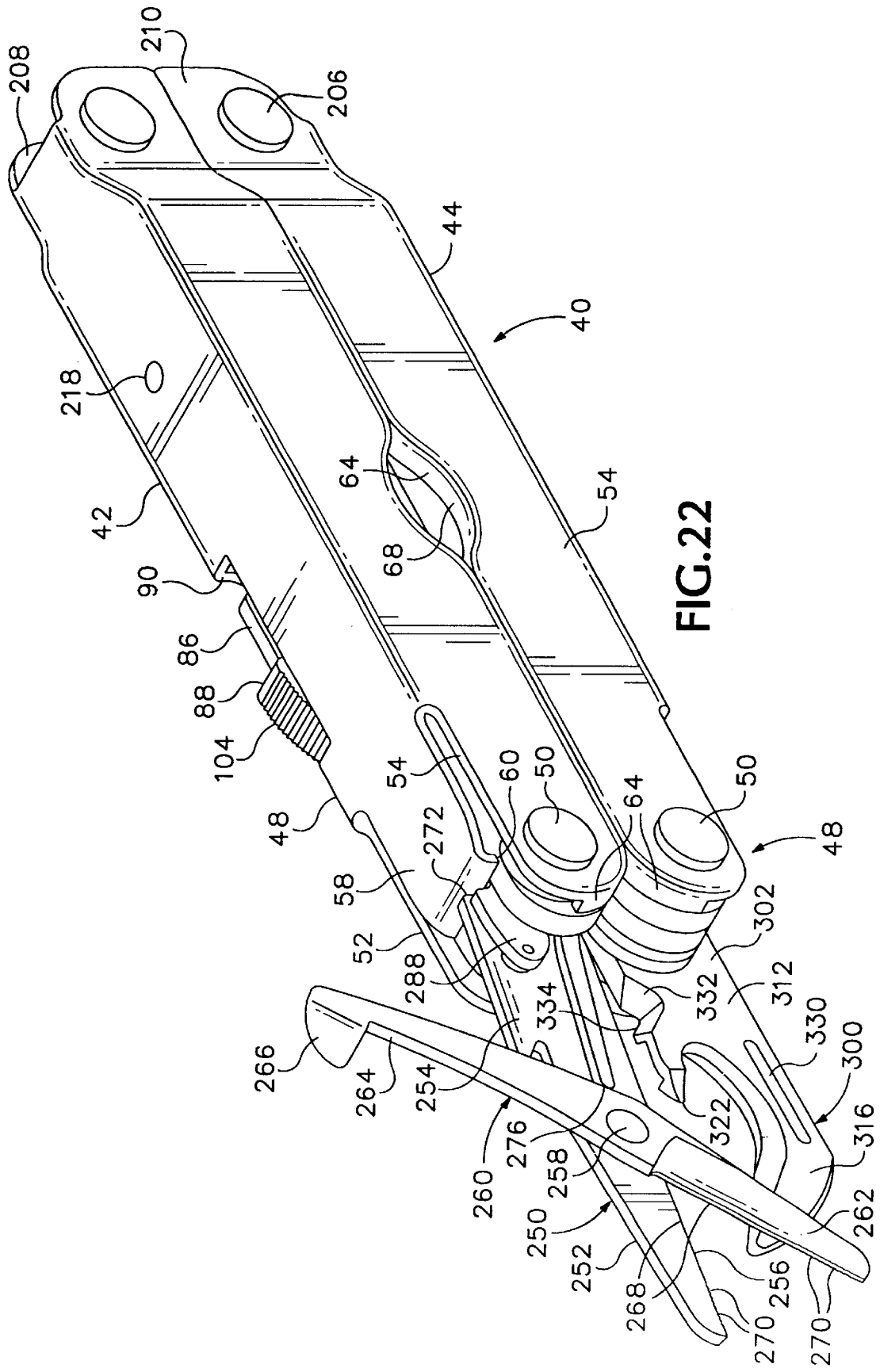
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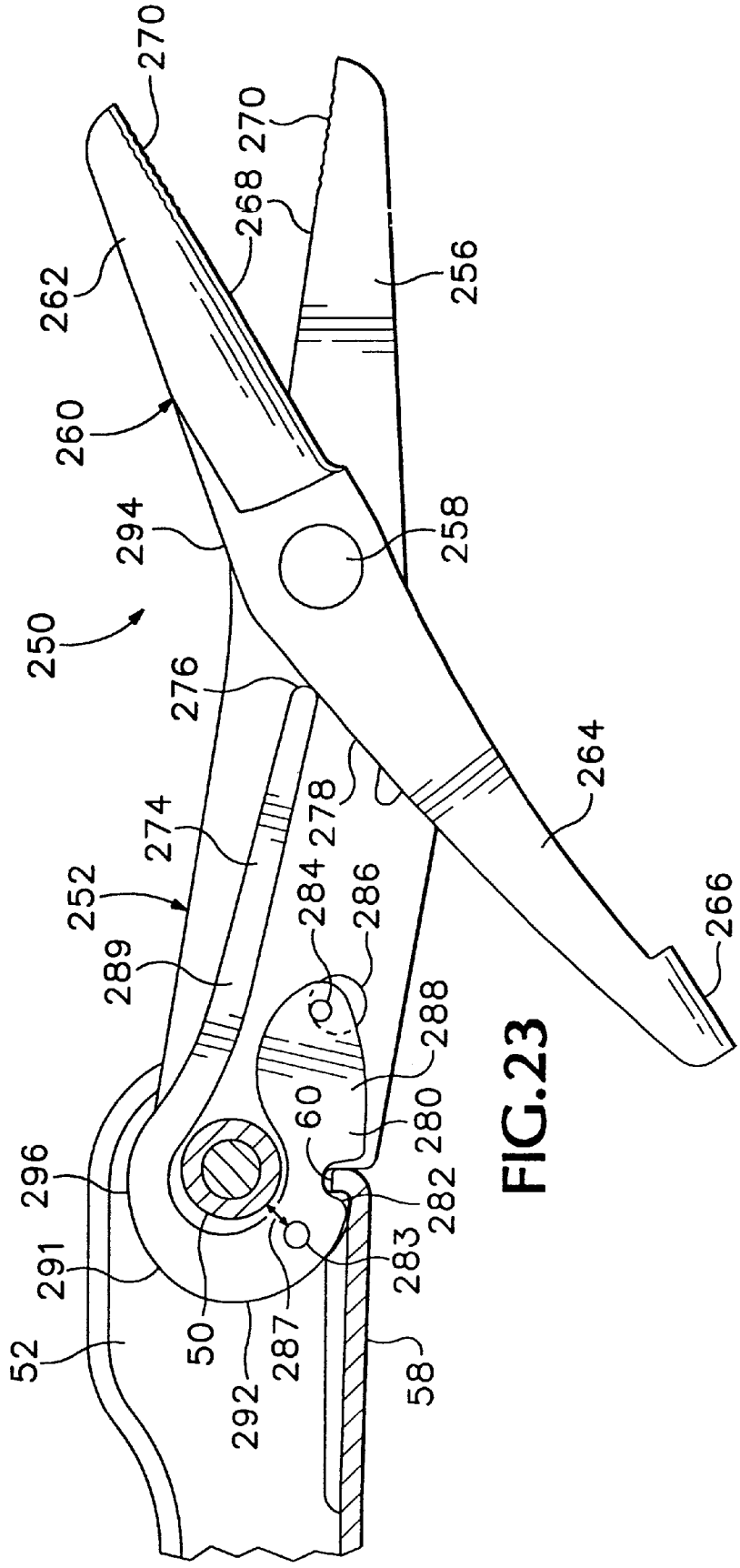
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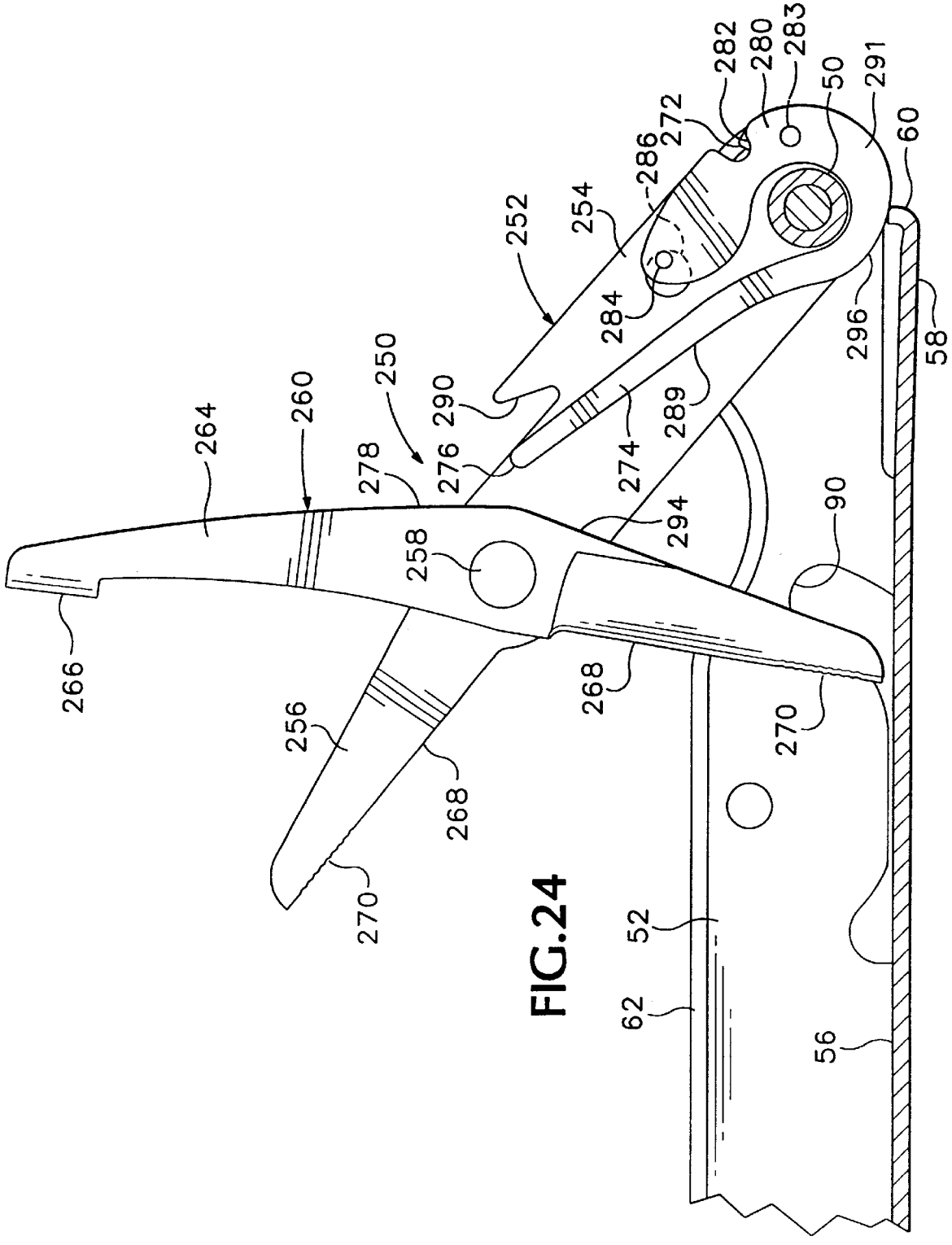
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FIG.24

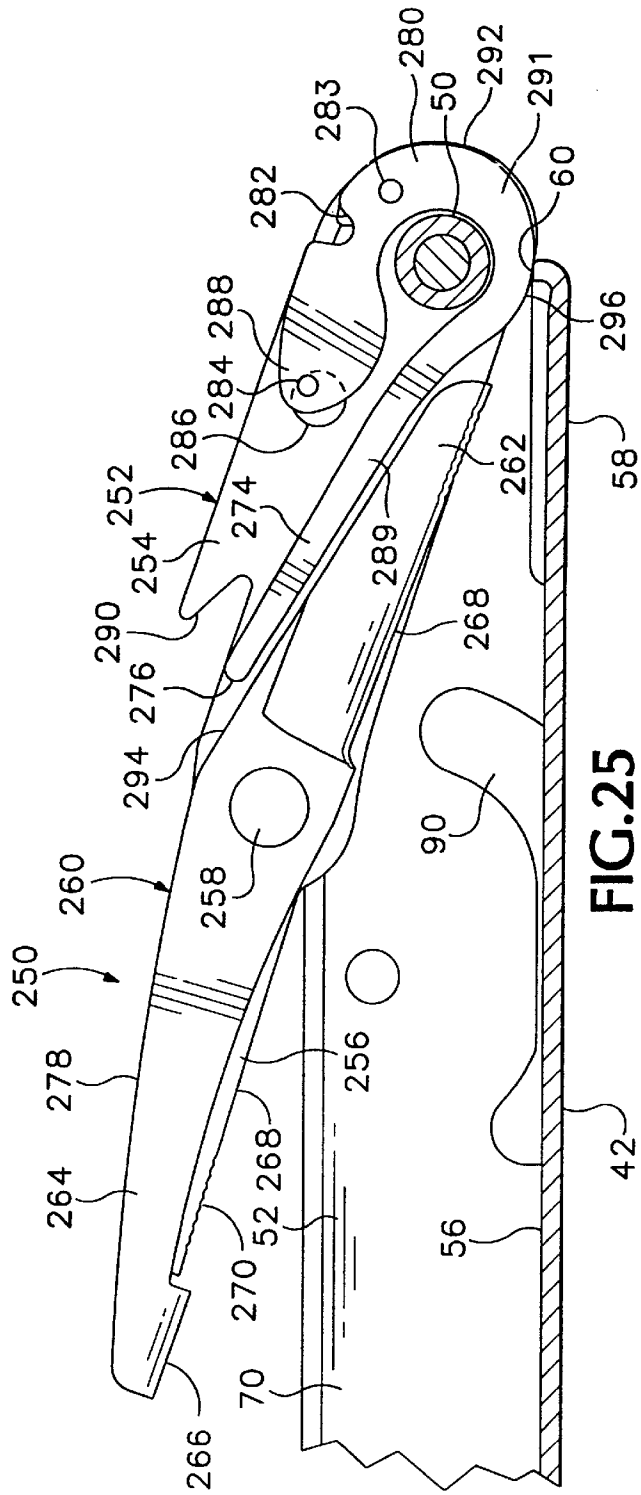
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FIG.25

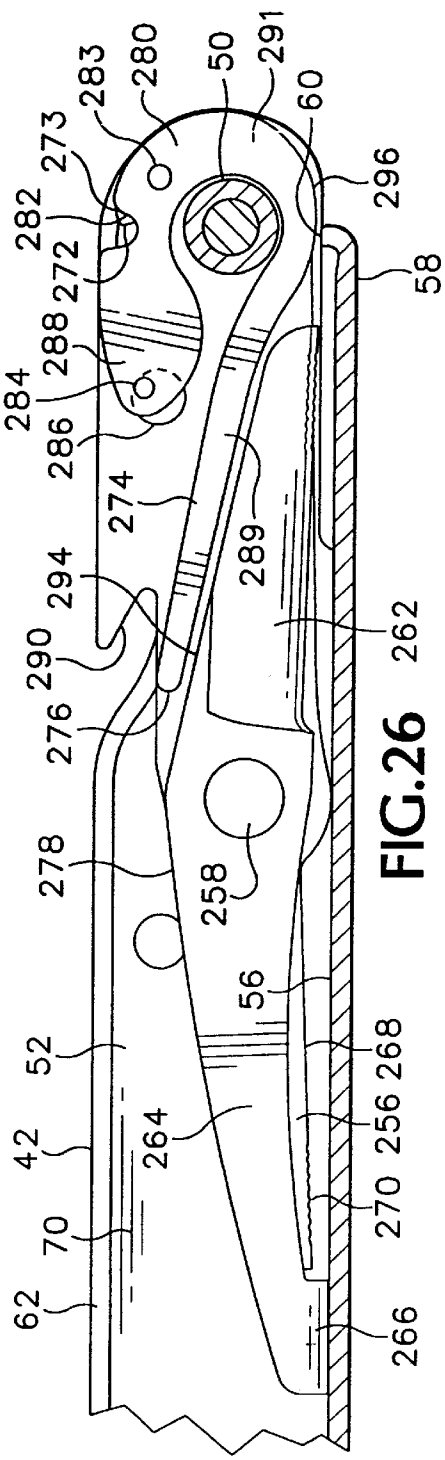
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FIG.26

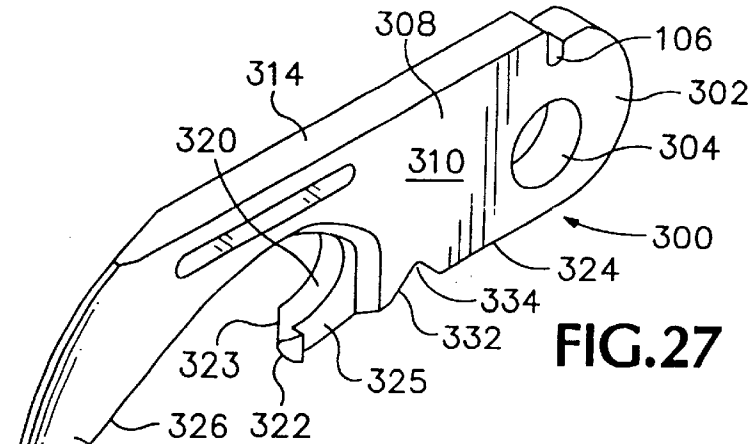


FIG.27

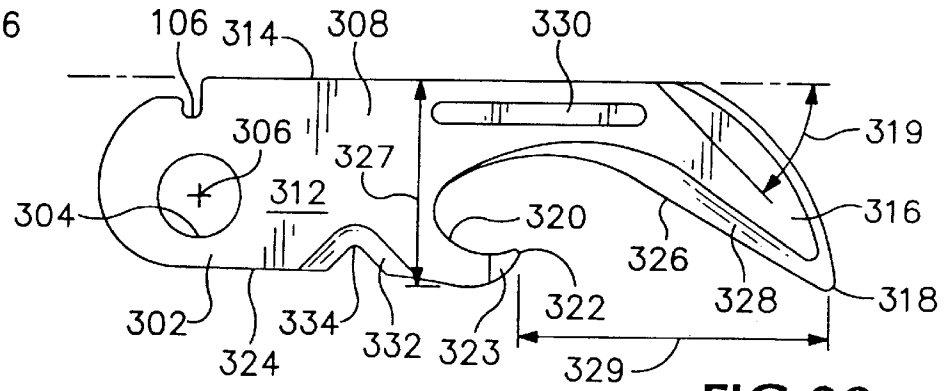


FIG.28

FIG.29

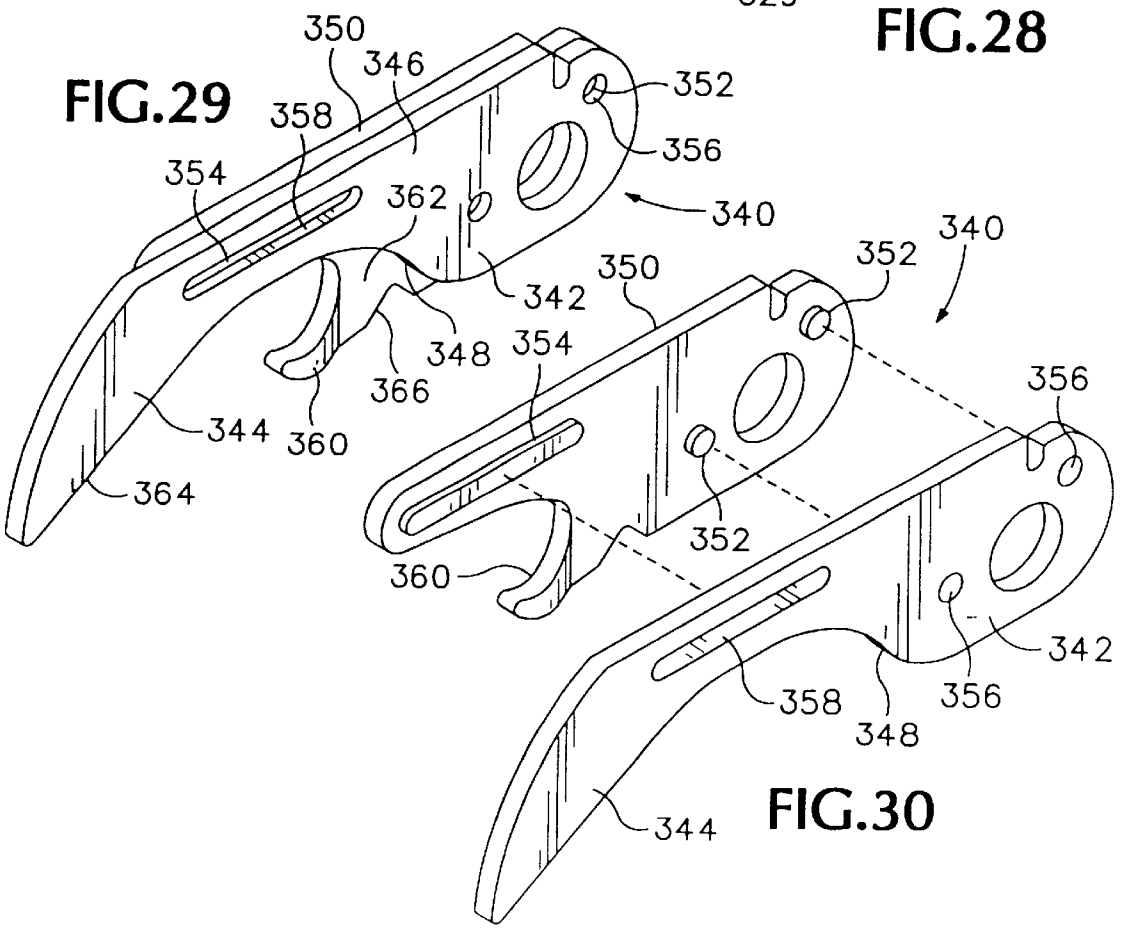


FIG.30

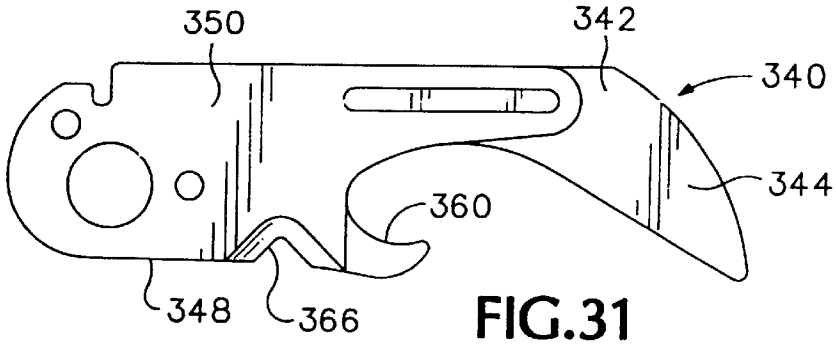


FIG.31

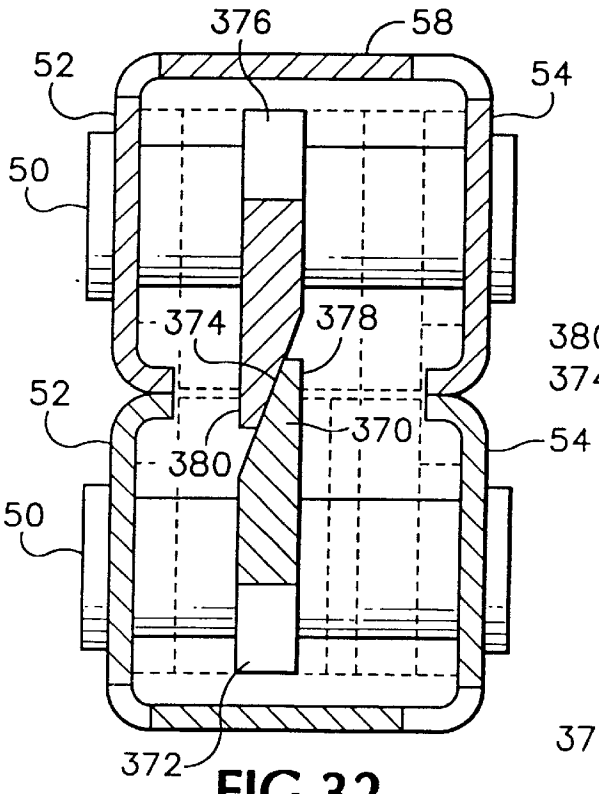


FIG.32

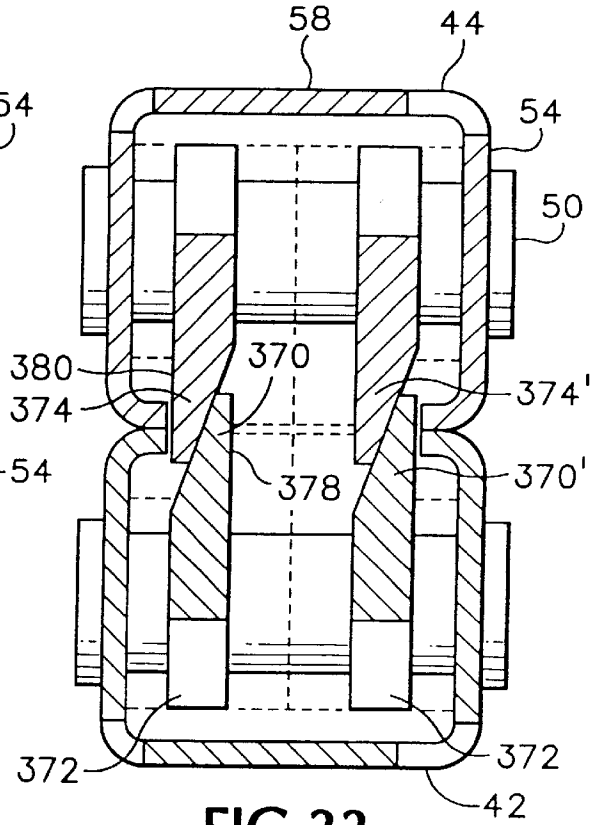


FIG.33

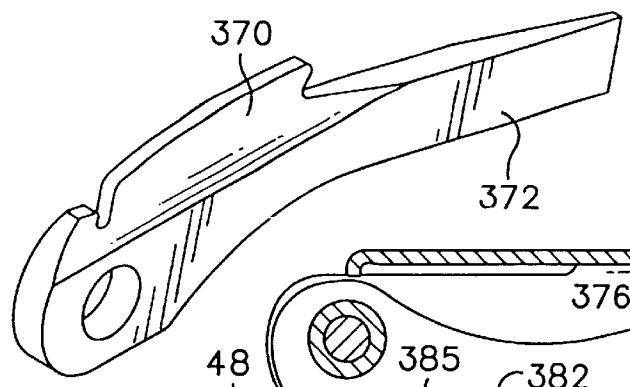


FIG.34

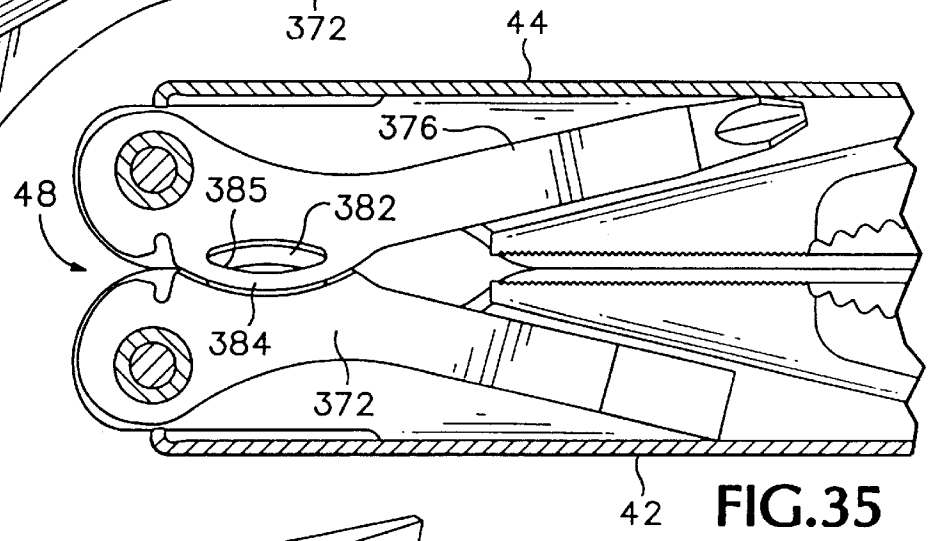


FIG.35

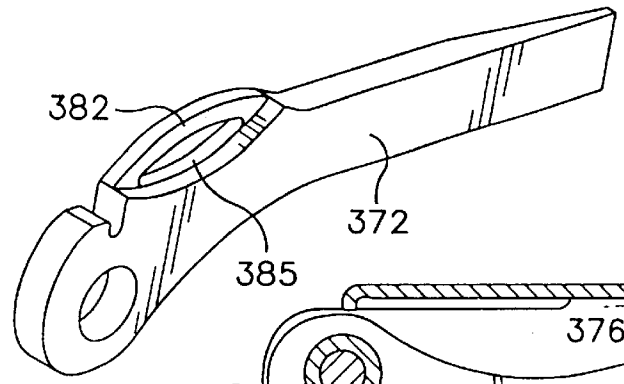


FIG.36

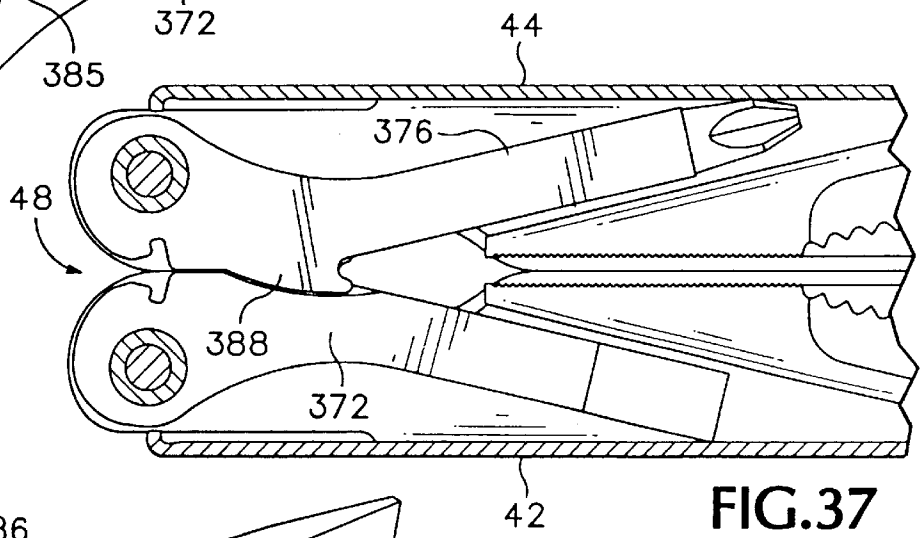


FIG.37

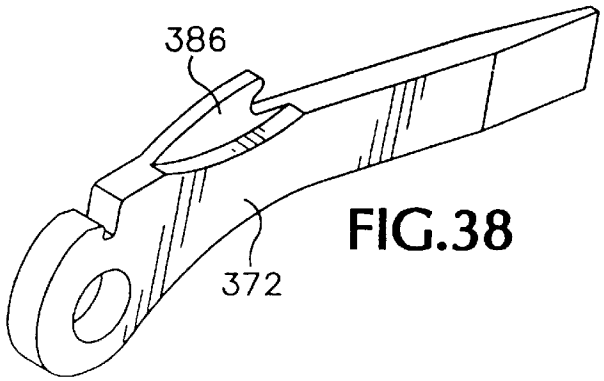


FIG.38

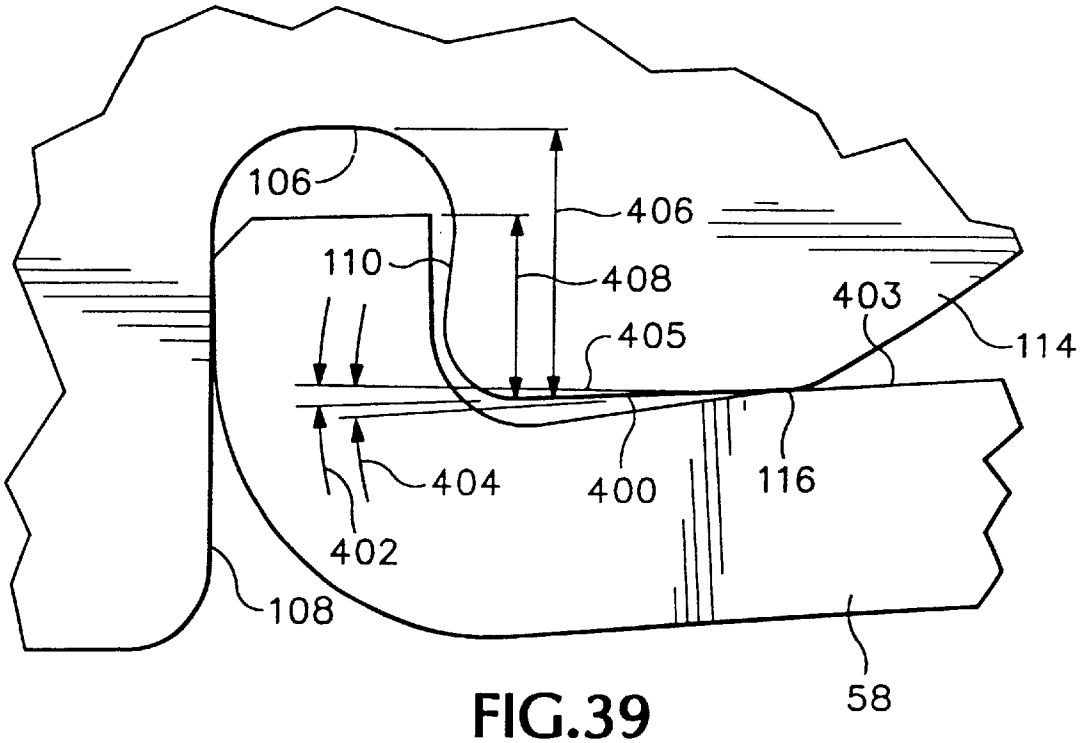

106
406
110
408
403
405
114
404
400
116
402
108
58

FIG.39

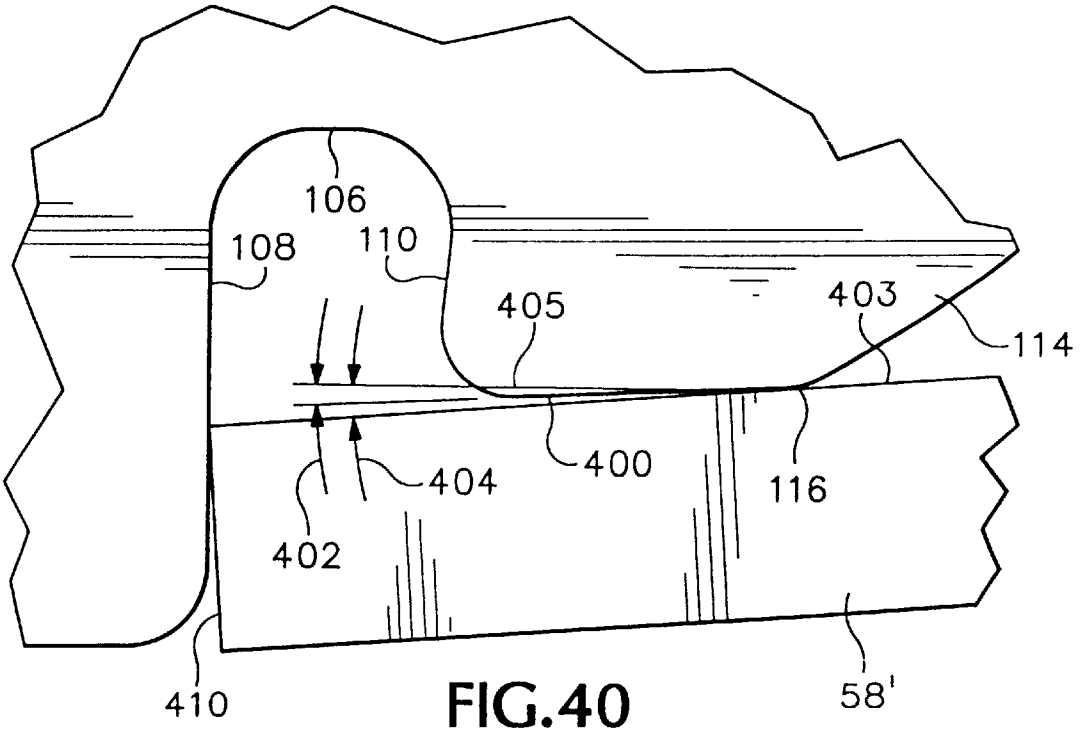
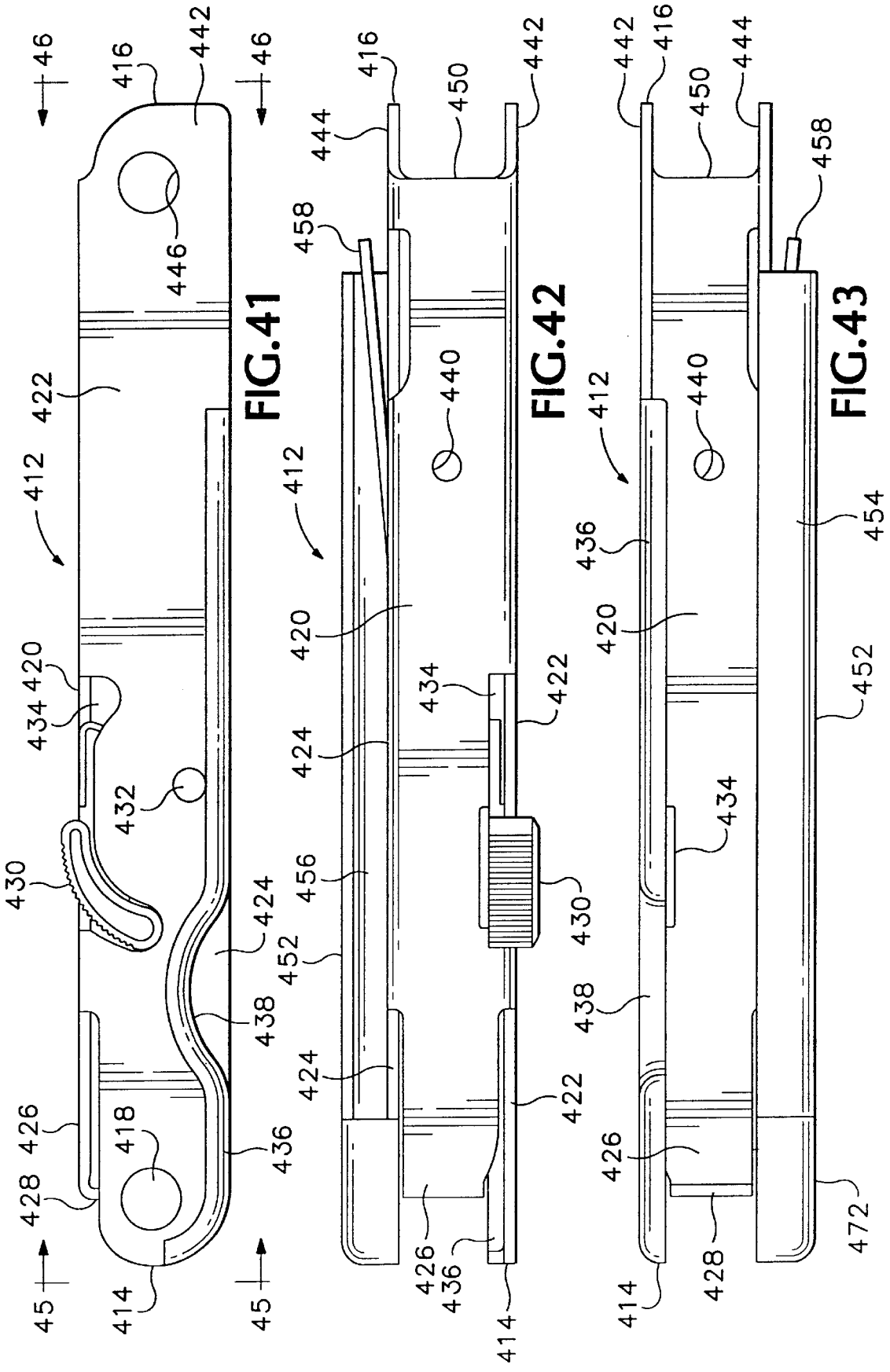

106
108
110
405
403
114
400
404
116
402
410
58'

FIG.40


46
416
442
446
422
412
434
420
432
430
424
456
452
438
426
418
428
436
414
45
FIG.41
444
450
458
440
FIG.42
454
FIG.43

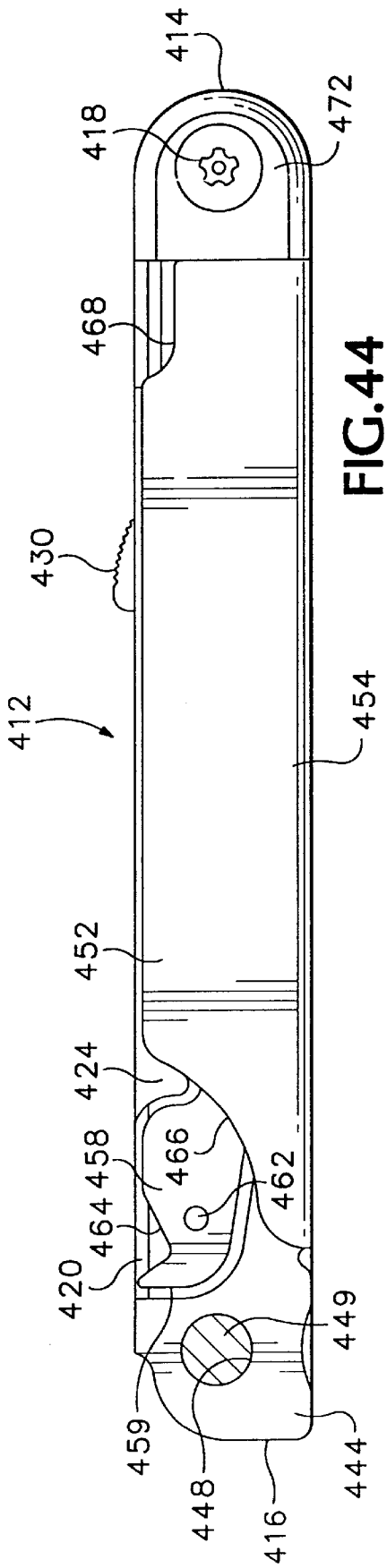


FIG.44

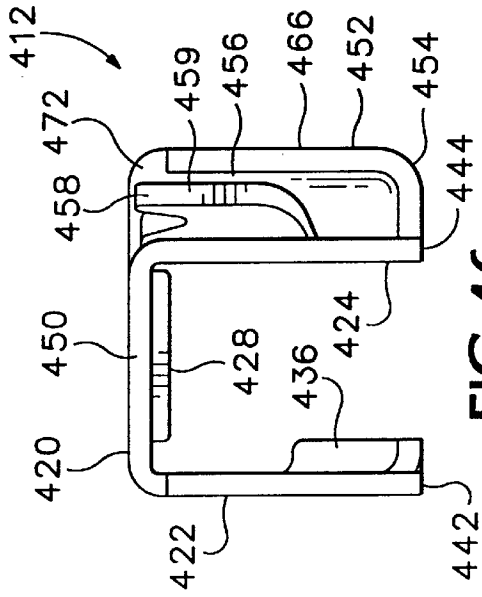


FIG.46

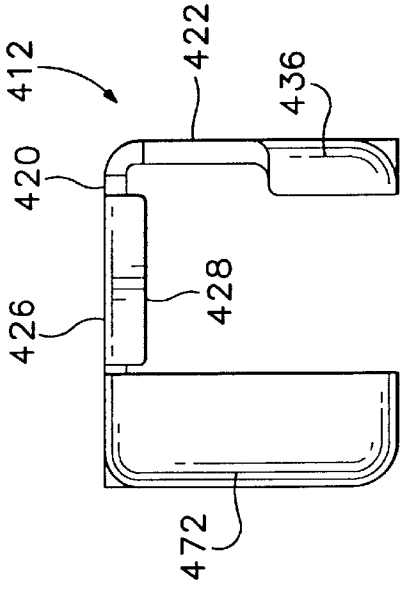


FIG.45

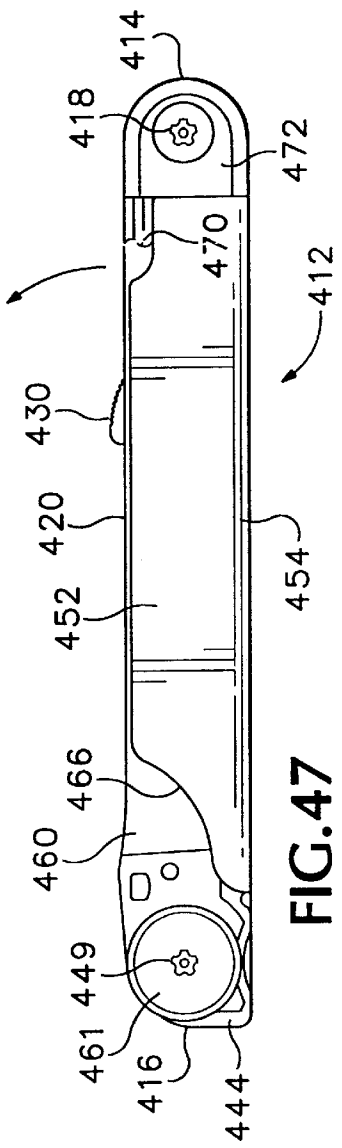

414
418
472
470
412
430
420
454
452
466
460
449
461
416
444

FIG.47

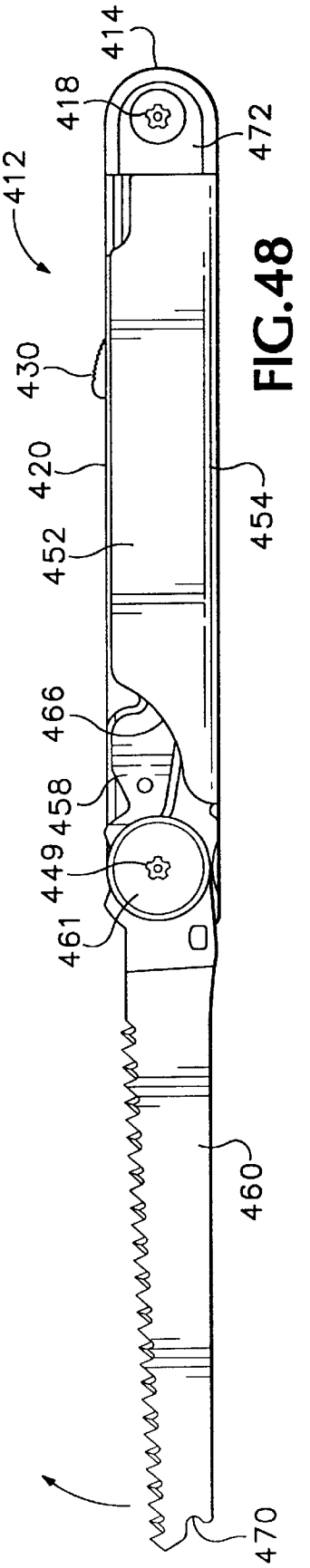

414
418
472
412
430
420
454
452
466
458
449
461
460
470

FIG.48

MULTIPURPOSE TOOL INCLUDING FOLDING SCISSORS

This application is a continuation-in-part of U.S. patent application Ser. No. 09/479,411, filed Jan. 12, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to a multipurpose folding tool, and particularly to such a tool including folding scissors, a blade latch release mechanism, and handles that provide comfort during use of pliers incorporated in such a tool.

As shown in Leatherman U.S. Pat. No. 4,238,862, Rivera U.S. Pat. No. 5,743,582 and Berg, et al., U.S. Pat. No. 5,745,997, multipurpose folding tools are well known and may contain folding pliers, various folding tool bits such as screwdrivers, files, and knife blades, and folding scissors that can be stored in cavities defined within handles configured as generally U-shaped channels. Tools of this type may include latches that hold a selected one of various screwdrivers or blades in an extended, operational position with respect to one of the handles, as shown in U.S. Pat. No. 5,979,059. Such tools may incorporate numerous types of handles, folding and latching arrangements, and folding scissors.

As useful as such folding multipurpose tools are, they still leave improvement desirable in certain details of their construction and operation. In particular, releasing certain latch mechanisms that hold selected blades in an extended position may require another blade or tool to be opened, or may entail use of a latch release lever that is located within a tool handle, occupying space that would better be occupied by a useful tool bit or blade. Accordingly, an improved latch release mechanism is desired. Preferably, such a latch release mechanism should be able to be operated easily, without the tool having to be held in a particular way in order to release a latched blade.

While functional blade latch mechanisms have previously been known in folding tools whose handles are of sheet metal construction, greater security for keeping a selected blade latch in an extended position is desired.

Most folding multipurpose tools having handles in the form of U-shaped channels have the open sides of the channels facing outwardly away from each other when the handles are unfolded to use a pair of pliers or similar tool jaws, in order to be able to receive the tool jaws within the channels when such a tool is folded. The channel sides, however, often have narrow edges that make use of such pliers uncomfortable. It is therefore desired to provide comfortable surfaces to be gripped when a multipurpose tool with handles in the form of channels is unfolded to permit use of the incorporated pliers or similar tools.

Construction of a folding multipurpose tool has previously required costly adherence to close manufacturing tolerances. Assembly of the pivot joint interconnecting a folding tool handle with a pliers jaw or the like has required adjustment by skilled personnel for the handles to be held securely in either an extended configuration or a folded condition with respect to a pair of tool jaws, yet also be folded and unfolded easily. It is therefore desired to provide a mechanism that permits smoothly folding and unfolding the handles, that operates reliably to hold the handles in a selected position with respect to such pliers jaws or the like, and that is less costly than the previously known corresponding mechanisms.

It is sometimes difficult to cut certain fibrous cords or bundles of strong fibers with scissors small enough for stowage in a folding multipurpose tool's handles. Small, tough fibers are sometimes squeezed out from between the scissors blades, and it is therefore desired to provide easily used folding scissors that overcome that problem.

Folding multipurpose tools have previously incorporated container openers intended to remove crown caps from bottles, to pierce the tops of beverage cans, and to remove the tops from cans used to preserve foods and the like. Such previously available openers have either been undesirably large, or if small enough to fit well within the space available in a folding multipurpose tool, such openers have tended not to function well in removing the tops from cans, often leaving rough or burred edges. It is therefore desired to provide a combination opener that performs well and reliably, without leaving excessively burred edges, yet is easily and inexpensively manufactured.

In using screwdrivers included in a folding multipurpose tool twisting forces may cause the handles of previously available tools to move undesirably with respect to each other. Also, where several blades may be stowed in a handle it is often difficult to open blades located between others. Tool construction that will keep a pair of handles securely located as they should be with respect to each other during use of such screwdriver blades, and that will also facilitate opening of a folded blade is therefore desired.

What is desired, then, is an improved multipurpose folding tool including improvements in some or all of the above-mentioned areas.

BRIEF SUMMARY OF THE INVENTION

The present invention provides answers to the needs mentioned above for improvements in various aspects of a folding multipurpose tool. In particular, in accordance with one aspect of the present invention, a blade latch release mechanism includes a latch release lever located within a channel-shaped handle for a multipurpose tool, adjacent one side of the handle. The latch release lever includes a protruding part which is moved to press against a latch spring and thus remove a catch from a notch defined in the base of a folding blade or tool bit.

In one preferred embodiment of a latch release mechanism according to the present invention a latch operating lever provides a force-multiplying mechanical advantage to move a cam arranged to move a latch release lever.

In one preferred embodiment of such a latch release mechanism an arcuate grip surface is located so as to provide an increasing lever arm length at the position where a person's thumb or finger is most likely to contact the grip surface during movement of the latch release operating lever, so that the mechanical advantage available to the user increases as the mechanism moves the latch spring further, and the force required to continue to move the latch release operating lever in releasing latch increases only slightly throughout the entire length through which the latch release operating lever has to be moved.

According to another aspect of the invention, the sides of the channel-shaped handle include rims merging with an outer surface of the handle in a smoothly arcuate surface. Such rims extend inwardly within the handle, defining a space for a portion of a latch release lever.

As another principal aspect of the present invention, the rim along the margin of each sidewall of the channel-shaped handle continues without interruption from one end of the handle to an opposite blade pivot end of the handle, providing a smooth, comfortable surface to be gripped, even in the areas where the margin of the sidewall is indented to give

access to blades or tool bits stowed within cavities defined by the handles.

In one embodiment of this aspect of the invention the rim extends inwardly far enough to engage the back of a blade adjacent the sidewall of the handle to keep such a blade stowed within the handle while other blades located closer to the center of the handle are raised from their stowed positions.

According to another major aspect of the invention, a spring is attached to the handle and rides on a cam surface on a tang of a pliers jaw to control pivoting motion of each handle with respect to the tangs of a pair of pliers jaws and, by camming action, to urge the handles into the fully extended position or into a folded position with respect to the pliers jaws once the handles approach such a position with respect to the tangs of the pliers jaws.

In one embodiment of this aspect of the invention, a raised portion of the tang of a pliers jaw cooperates with a lateral surface on the spring to keep the spring aligned properly with the tang.

In such an embodiment of this aspect of the invention, the spring may have a forked outer end including a pair of prongs located on opposite sides of a centrally located raised portion of the tang of a pliers jaw.

In another embodiment of this aspect of the invention an interference bump is provided on the raised portion of the tang of a pliers jaw to engage an interior surface of the channel-shaped handle at the same time the spring acts in a cam-following manner on the cam surface of the pliers jaws to hold a handle securely in a fully extended position with respect to the tang of a pliers jaw.

Another aspect of the present invention is the provision of a folding scissors whose blades include edges that are straight except for a serrated portion on either or both of the blades near their outer tips.

In one preferred embodiment of the folding scissors aspect of the present invention, a spring extends alongside a base portion of one of the legs of the scissors and engages the other leg of the scissors to return the scissors blades to an open position after a cutting stroke of the scissors. In a preferred embodiment of this aspect of the invention, the spring extends from a base which is coupled to the first scissors leg with some freedom to pivot to provide clearance to permit the scissors to be folded and stowed within a cavity defined within one of the handles, with the-spring relaxed when the scissors are stowed. In a preferred embodiment of the invention, the spring extends generally in the shape of a "U", providing ample length to avoid excessive stress.

According to another aspect of the present invention a container opener includes a hook with a throat area behind the tip of the hook to provide clearance for a crimped rim of a container such as a "tin" can, and a sharp edge on the front part of the opener faces back toward the tip of the hook to cut free the top of such a container efficiently.

As yet another aspect of the present invention, interlocking portions of folded blades stowed within the cavities defined by the handles of the tool extend closely alongside each other, between such interlocks and other blades or tool bits stowed within the opposite handles, preventing the handles from moving laterally with respect to each other when the handles are folded together about the associated pliers jaws or the like.

The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a perspective view of a folding multipurpose tool embodying the present invention with a large screwdriver extended for use.

FIG. **1A** is a perspective view of the folding multipurpose tool shown in FIG. **1**, with the handles unfolded to deploy a pair of pliers jaws for use, and showing how a person may use a thumb to operate a blade latch release mechanism.

FIG. **2** is an end view taken from the left end of the multipurpose tool shown in FIG. **1**, in a folded configuration, with the screwdriver shown in FIG. **1** folded.

FIG. **3** is a section view, taken generally along line **3—3** in FIG. **1**, showing a portion of the blade latch release mechanism as well as the bases of exemplary tool blades.

FIG. **4** is an elevational view from the near side of the lower handle of the multipurpose tool as shown in FIG. **1**, partially cut away to show clearly the blade latch release mechanism, with the blade latch fully engaged to hold a screwdriver blade in an extended position as shown in FIG. **1**.

FIG. **5** is a view similar to FIG. **4**, with the blade latch release operating lever moved a short distance in the direction required for releasing the latch catch from the screwdriver blade.

FIG. **6** is a view similar to that of FIGS. **4** and **5** showing the latch release mechanism disengaging the catch fully from the extended screwdriver blade.

FIG. **7** is a view similar to that of FIG. **4**, but with the screwdriver blade partly folded toward its stowage position so that a cam portion of the base of the screwdriver blade displaces the latch spring away from the latch release lever of the latch release mechanism.

FIG. **8** is a view similar to that of FIG. **4**, but with the screwdriver blade folded into its position for stowage in the handle, and with the latch release mechanism in a relaxed state.

FIG. **9** is a top plan view of a portion of a handle and a portion of a blade for a multipurpose tool similar to that shown in FIG. **1**, but including a different latch release mechanism associated therewith.

FIG. **10** is a partially cutaway side elevational view of the portions of a tool handle and extended blade shown in FIG. **9**, with the latch release mechanism holding the catch disengaged from the base of the extended tool blade.

FIG. **11** is a top plan view of a portion of a handle and a portion of a blade for another multipurpose tool similar to that shown in FIG. **1**, but including another different latch release mechanism.

FIG. **12** is a partially cutaway side elevational view of the portions of a tool handle and extended blade shown in FIG. **11**, with the latch release mechanism holding the catch disengaged from the base of the extended tool blade.

FIG. **13** is a top plan view of a portion of a handle and a portion of a blade for yet a further multipurpose tool similar to that shown in FIG. **1**, but including yet a different latch release mechanism associated therewith.

FIG. **14** is a partially cutaway side elevational view of the portions of a tool handle and extended blade shown in FIG. **13** with the latch release mechanism holding the catch disengaged from the base of the extended tool blade.

FIG. **15** is a partially exploded isometric view from above one end of one of the handles of the tool shown in FIG. **1**, showing a pair of jaws and a portion of the other handle.

FIG. **16** is a section view of a portion of the tool shown in FIG. **1**, with the handles engaged with the tangs of the jaws of a pair of pliers which are included in the tool.

FIG. **17** is a section view taken along line **17**—**17** of FIG. **1**, at an enlarged scale, omitting some tool blades for the sake of clarity.

FIG. **18** is a perspective view of a spring which forms a part of a jaw handle retention mechanism which is incorporated in the invention.

FIG. **19** is a view, taken in the direction of line **19**—**19** in FIG. **16**, showing a portion of one of the handles of the multipurpose tool.

FIG. **20** is a section view taken along line **20**—**20** in FIG. **16**, showing the relationship of a spring to the base of the pliers jaw and to the handle shown in FIG. **19**.

FIG. **21** is a view of the multipurpose tool shown in FIG. **1**, in a folded configuration, taken from the right end of the tool as shown in FIGS. **1** and **17**.

FIG. **22** is an isometric view taken from the blade pivot end of the multipurpose tool shown in FIG. **1**, but with the tool rotated 180° and thus showing the opposite side of the tool from that shown in FIG. **1**, and showing a pair of folding scissors and a combination bottle opener and can opener both latched into their extended positions with respect to the handles.

FIG. **23** is a side elevational view of the folding scissors in its fully-extended operational position, together with a partially cutaway portion of a portion of the tool handle with which it is associated, with the latch release mechanism shown in FIGS. **1**–**8** omitted for the sake of clarity.

FIG. **24** is a view of the folding scissors and somewhat larger partially cutaway portion of the handle shown in FIG. **23**, with the scissors in a partially folded position approaching their stowage position within the tool handle.

FIG. **25** is a view similar to FIG. **24**, but with the scissors blades and handle moved further toward their stowage position and in the position with respect to each other required for stowage of the folding scissors within the tool handle.

FIG. **26** is a view similar to FIG. **25**, showing the folding scissors stowed within the tool handle.

FIG. **27** is an isometric view from the upper left front of a combined can opener and bottle opener included in the multipurpose folding tool shown in FIGS. **1** and **22**.

FIG. **28** is a right side elevational view of the combined can and bottle opener shown in FIG. **27**.

FIG. **29** is an isometric view, taken from the upper left front, of a combined bottle opener and can opener which is another embodiment of one aspect of the present invention.

FIG. **30** is an exploded isometric view taken from the upper left front of the opener shown in FIG. **29**.

FIG. **31** is a right side elevational view of the opener shown in FIGS. **29** and **30**.

FIG. **32** is a section view taken on line **32**—**32** of FIG. **17**, showing an interlocking relationship between two of the folded tool blades contained within the handles of the tool.

FIG. **33** is a view similar to FIG. **32** showing a tool including two pairs of interlocking blades.

FIG. **34** is an isometric view of a screwdriver which is one of the two interlocking tool blades shown in FIGS. **17** and **32**.

FIG. **35** is a view similar to part of FIG. **17**, showing a portion of a folding tool including two interlocked tool blades of a form somewhat different from that shown in FIG. **17** and **32**.

FIG. **36** is an isometric view of a screwdriver which is one of the two interlocking tool blades shown in FIG. **35**.

FIG. **37** is a view similar to FIG. **35** showing two interlocked tool blades of another form somewhat different from that shown in FIGS. **35** and **36**.

FIG. **38** is an isometric view of a screwdriver which is one of the two interlocking tool blades shown in FIG. **37**.

FIG. **39** is a side elevational view, at an enlarged scale, of a detail of the blade latch mechanism of the folding multipurpose tool shown in FIG. **1**, showing the catch engaged in a notch to hold a folding blade in its extended position with respect to the tool handle including the latch mechanism.

FIG. **40** is a view similar to that of FIG. **39**, showing a latch spring without a catch, holding a tool blade in an extended position with respect to the handle of a multipurpose tool similar to that shown in FIG. **1**.

FIG. **41** is a right side elevational view of a handle for a folding multipurpose tool embodying the present invention and corresponding generally with one of the handles of the tool shown in FIG. **1**.

FIG. **42** is an outside, or top plan view of the tool handle shown in FIG. **41**.

FIG. **43** is an inside, or bottom plan view of the tool handle shown in FIGS. **41** and **42**.

FIG. **44** is a left side elevational view of the tool handle shown in FIGS. **41**–**43**.

FIG. **45** is an end elevational view taken from the blade pivot end of the handle shown in FIG. **41**, in the direction indicated by line **45**—**45**.

FIG. **46** is an end elevational view taken from the tool jaw end of the tool handle shown in FIG. **41**, in the direction indicated by line **46**—**46**.

FIG. **47** is a left side elevational view of the tool handle shown in FIG. **44**, together with an outer blade stowed in the side trough.

FIG. **48** is a left side elevational view of the tool handle shown in FIG. **47**, shown with the outer blade extended.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings which form a part of the disclosure herein, a multipurpose folding tool **40** has a pair of handles **42** and **44** shown in a folded configuration in FIGS. **1** and **2**, and unfolded in FIG. **1**A. A straight screwdriver blade **46** is shown in an extended position in FIGS. **1** and **1**A, but is shown folded into a stowage position in FIG. **2**. Each handle **42**, **44** has a first, or blade pivot end **48**, at which various tool bits such as screwdriver blades, knife blades, files, and folding scissors are attached to the handle **42** or **44** by a respective pivot pin **50** extending through and between the opposite sidewalls **52**, **54** of each handle **42**, **44**. The handles **42**, and **44** are of sheet metal, blanked and pressed into the form of a generally U-shaped channel in which a channel base **56** is the back or outer side of each handle **42** or **44** when the multipurpose tool **40** is folded as shown in FIG. **2**. The sidewalls **52**, **54** join the channel base **56** along bends providing rounded corners for a comfortable grip.

Blade Latch Release

A latch spring **58** is an extension of the channel base **56**, and at an outer end of the latch spring **58** the sheet metal is bent downwardly, forming a catch **60** that extends generally perpendicular to the spring **58** over substantially the entire width, or combined thicknesses, of all of the folded tool bits and blades attached to the end **48** of the handle **42** or **44**. As

will be explained in greater detail subsequently, the catch **60** is available to engage one or more extended tool bits or blades to keep each in its extended position.

An inwardly directed rim **62** extends along the margin of each sidewall **52**, and a similar inwardly directed rim **64** extends along the margin of each sidewall **54**. The rims **62**, **64** merge smoothly with the sidewalls **52**, **54** in a rounded surface along the margins of the sidewalls **52**, **54**. The rims **62**, **64** are directed inwardly toward each other, extending along a portion of the end **48** of each handle **42**, **44** and thence continuously along the remainder of the margin of each sidewall **52**, **54** toward the opposite second, or tool jaw, end **66** of each handle. The rims **62**, **64** follow the contour of each of the sidewalls **52**, **54**, also extending along indentations **68** (FIG. **4**) in the margins of the sidewalls. The indentations **68** provide access to nail nicks of blades stored adjacent the sidewalls in the cavities **70** in the handle **42** and a cavity **72** defined in the handle **44**. The rims **62** and **64**, together with the rounded surfaces where the rims **62**, **64** merge with the sidewalls **52** and **54**, give a larger area to be gripped and squeezed, and thus provide for a more comfortable grip on the handles **42** and **44** when they are unfolded as shown in FIG. **1**A, with respect to a pair of pliers jaws **200**.

The latch spring **58** is separated from the adjacent sidewalls **52** and **54** along its length and is narrower, at least adjacent its outer end **74**, than the space between the opposed interior edges of the rims **62** and **64**, as may be seen in FIG. **2**. As a result, the outer end **74** of the latch spring **58** is accessible between the sidewalls **52** and **54**, and may be trimmed to the appropriate length and be bent down to form the catch **60** after the sidewalls **52** and **54** and rims **62** and **64** have been formed, if desired, during manufacture of the handles **42** and **44**.

Additionally, space is provided as shown in FIG. **2** for an axial spacer **77** fitted on the pivot pin **50** adjacent the sidewall **54** of the handle **44**, where the spacer **77** can be rotated alongside the margin **76** of the latch spring **58** to carry an attached lanyard eye **78** into the cavity **72** for stowage if desired.

The other side of each latch spring **58**, nearer to the sidewall **52** of each handle, extends closely alongside the margin of the sidewall **52** for a majority of its length and then is tapered inward, as shown at **80**. The portion of the latch spring **58** extending alongside the channel sidewall **52** is available to be contacted by a protruding shoulder **82** on a latch release lever **84** mounted on the pivot pin **50**. The latch release lever **84** preferably has a portion **85** which extends radially outward away from the pivot pin **50** to conform with the profile of the cam portions of the bases of the tool bits and blades, thus offering some lateral stabilizing support against the bases of those blades, and contributing to a neat appearance of the blade pivot end **48** of the handle.

A latch release operating lever **86** includes a knob or handle portion in the form of a rocker body **88** that extends outward from the cavity **70** or **72** within each handle through an opening **90** defined by both the sidewall **52** and the channel base **56** or back of each of the handles **42** and **44**. It will be understood that the openings **90** in the two handles are mirror images of each other, as are the latch release operating levers **86** located in the two handles **42** and **44**. While the latch release operating lever **86** may be manufactured by traditional machining processes, it may also be manufactured by powder metallurgy or metal injection molding methods.

Each latch operating lever **86** is attached to the adjacent sidewall **52** by a fastener such as a rivet **92**, defining a latch release operating lever pivot or fulcrum whose axis **94** extends normal to the sidewall **52**, so that the operating lever **86** can rotate about the fulcrum in a plane parallel with and adjacent to the sidewall **52**. Preferably, the rivet **92** is countersunk in the latch operating lever **86** to preserve clearance for folding tool blades to be stowed within the handles **42** and **44**.

Opposite ends **96** and **98** of the rocker body **88** include limit surfaces, and portions **100** and **102**, respectively, of the surfaces defining the opening **90** through the handles **42** and **44** are limit stops to be encountered by the limit surfaces of the ends **96** and **98** to limit the rotation of the latch release operating lever **86** about the fulcrum **94**.

An outer face or grip surface **104** of the rocker body **88** is arcuate, and has a shape approximating a sector of a short cylinder. Preferably, outer grip surface **104** is knurled or grooved to facilitate being gripped by a persons thumb or finger. The rocker body **88** extends laterally beyond an outer face **105** of the sidewall **52**, and also is exposed proud along the back **56** of the respective handle **42** or **44**, making it easy to pivot the latch release operating lever **86** about its fulcrum **94**, by moving either one's thumb or finger along the surface of the channel base **56** or along the sidewall **52**. The somewhat larger end **96** of the rocker body **88** contributes to comfort when pushing against that end of the rocker body **88** as shown in FIG. **1**A rather than against the grip surface **104** to release the catch **60** from engagement with one of the folding blades or tool bits that has been latched into a position extending from one of the handles **42** or **44**. As may be seen in FIG. **1**A it is practical to operate the latch release mechanism with respect to either of the handles **42** or **44** while holding the tool **40** with its handles **42** and **44** extended with respect to a pair of pliers jaws **200**.

As may be understood more clearly with reference to FIGS. **4**–**8**, when a blade or tool bit attached to the handle **42** by the pivot pin **50**, such as the screwdriver blade **46**, is latched in its open, extended position as shown in FIGS. **1** and **4**, the catch **60** extends into a notch **106** in the base **114** of the blade. A shoulder **108** is engaged by an outer face of the catch **60** to prevent the blade from rotating too far in the direction of extension, while an inner face of the catch **60** engages an inner face **110** of the notch **106** to prevent the latched, extended blade from rotating about a pivot axis **112** defined by the pivot pin **50** toward a stowed position within the cavity **70**.

A peripheral surface of the base **114** of the screwdriver **46** or other blade or tool bit acts as a cam, with a lobe **116** that presses against the latch spring **58**, deflecting it slightly outward from its relaxed position parallel with the channel base or back **56** of the handle **42**, when the catch **60** is engaged in the notch **106**. Pressure of the latch spring **58** against the cam lobe **116** urges the screwdriver blade **46** toward its extended position by creating a counterclockwise moment about the pivot axis **112**.

The elastic force of the latch spring **58** pressing against the lobe **116** must be overcome in moving the outer end **74** and the catch **60** far enough to disengage the catch **60** from the notch **106** in order to fold the screwdriver blade **46** into the cavity **70**. This is accomplished by rotating the latch release lever **84** far enough (in a clockwise direction as shown in FIGS. **4**–**8**) about its axis of rotation to move the shoulder **82** into contact with the latch spring **58** and by continuing movement of the latch release lever **84** in the same direction, to cause the shoulder **82** to deflect the latch spring **58** far enough to release the catch **60** from the notch **106**.

In the latch release mechanism depicted in FIGS. **4**–**8**, the latch release lever **84** is moved when the latch release

operating lever **86** is moved by a person engaging the rocker body **88** with a thumb or finger.

As may be seen best in FIG. **3**, the pivot pin **50** is preferably a hollow-ended pin and a screw with mating threads extending through corresponding bores in the sidewalls **52** and **54**. Preferably, a shoulder **118** is provided on the pivot pin **50**, keeping the folding tool bits and blades including the screwdriver **46** away from the sidewall **52** to provide ample room axially along the pivot pin **50** for free rotation of the latch release lever **84** about the larger-diameter portion of the pivot pin **50**.

Using this construction the axis of rotation of the latch release lever **84** coincides with the pivot axis **112** about which the folding blades and tool bits rotate between their respective extended positions and their stowed positions within the cavities **70** and **72**. It will be understood, however, that it would be feasible to provide a separate axis of rotation for the latch release lever **84**, as by providing a rivet connecting the latch release lever **84** with the sidewall **52**.

It will be seen in FIG. **4** that the latch release operating lever **86** includes two effective lever arms. A longer lever arm **120** is present between a fulcrum **94** and an effective point of contact **121** between a person's thumb or finger and the grip surface **104** of the rocker body **88**. A shorter lever arm **122** is present between the fulcrum **94** and a point of contact of an end **124** of the latch release lever **84**, following a cam surface **126** of a lever lifting cam portion of the latch release operating lever **86**.

It will be appreciated also that the grip surface **104** is not centered upon the pivot axis or fulcrum **94** of the latch release operating lever **86**, but is eccentrically located with respect to the fulcrum **94**. The grip surface **104** thus approximates a portion of a spiral expanding outward in a clockwise direction about the fulcrum **94**. The effective length of the longer lever arm **120** of the latch release operating lever **86** increases as the latch release operating lever **86** is moved, because the latch release operating lever **86** is moved by pressing one's thumb toward the back **56** of the handle **42** to engage the grip surface **104** and then moving the thumb longitudinally along the back **56** of the handle in the direction away from the blade pivot end **48**. Since the thumb's effective point of contact **121** moves along the grip surface **104**, the longer lever arm **120** increases in length as the latch release operating lever **86** is rotated counterclockwise, away from the blade pivot end **48**, to the position shown in FIG. **5**. The lever arm **120** continues to increase in effective length as the latch release operating lever **86** is rotated further to the position in which the limit surface **98** encounters the stop **102**, as shown in FIG. **6**.

Because of the shape of the cam surface **126**, however, the length of shorter lever arm **122** first increases and then decreases. Thus, for a force directed longitudinally along the back **56** of the handle **42** and applied at a point **121** where one's thumb or finger is tangent to the surface **104**, as the latch release operating lever **86** is rotated to approach the position shown in FIG. **6** where the catch **60** is released from the notch **106**, the combined mechanical advantage provided by the changing lengths of the longer lever arm **120** and the shorter lever arm **122** first decreases and then increases to be greater than the initial mechanical advantage. This mechanical advantage, provided as the latch release lever is moved by the latch release operating lever **86**, compensates partially for the increasing force required at the end **124** to rotate the latch release lever **84** as the shoulder **82** deflects the latch spring **58** further from its relaxed position. As a result, the force that must be exerted on the grip surface **104** by one's thumb or finger, in a direction parallel with the back **56**, is much less than the force required at the end **124**, even as the spring **58** is deflected further and requires greater force. Also, the shoulder **82** moves slightly toward the outer end **74** of the spring **58** as the latch release lever **84** moves about its axis of rotation **112**, as shown by the arrow **125** in FIG. **4** and the shorter arrow **127** in FIG. **6**. This slightly lessens the increase in force required at the end **124** to move the latch release operating lever **86** further.

When the limit surface of the end **98** of the rocker body **88** encounters the stop **102**, the latch release lever **84** preferably does not protrude through the opening **90** more than a very small amount, as shown in FIG. **6**, but the spring **58** is deflected sufficiently to raise the catch **60** and to release it from the notch **106**, as shown in FIG. **6**, allowing the screwdriver blade **46** to be rotated clockwise toward its stowed position. The stop **102**, moreover, prevents the latch release lever **84** from flexing the latch spring **58** beyond its elastic limit.

As shown in FIG. **7**, a peripheral surface of the base **114** of the screwdriver blade **46** acts as a cam followed by the catch **60** as the spring **58** moves back toward its substantially relaxed position shown in FIG. **8**. Preferably, sufficient pressure is provided against the sides of the bases of the tool bits and blades, by the shoulder **118** and the head of the pivot pin **50** adjacent the outer side of the sidewall **54**, to keep the tool bits and blades from flopping too easily out from their respective stowed positions in the cavities **70** and **72**. Once a tool bit or blade has been moved a part of the way toward its respective extended position, the base **114** of each will act as a cam to lift the catch **60**, which can follow the cam surface until the catch **60** can engage itself into the respective notch **106**.

Preferably, the latch release lever **84** has a thickness **128** (FIG. **3**) which is greater than the thickness **129** (FIG. **1**) of the latch release operating lever **86**, assuring that the adjacent one of the blades stowed within the cavity **70** or **72** does not interfere with the latch release operating lever **86**.

When all of the tool bits or blades in one of the handles **42** and **44** are in their stowed positions, as shown in FIG. **8**, the latch spring **58** preferably rests on the shoulder **82** of the latch release lever **84** with a small amount of pressure biasing the latch release lever **84** in a counterclockwise direction as shown in FIG. **8**. This urges its outer end **124** against the cam portion, in turn urging the latch release operating lever **86** to rotate clockwise and thus bringing the limit surface of the end **96** of the rocker body **88** into engagement against the stop **100**. The latch release lever **84** includes a crook in its shape, fitting around the shape of the stop surface **100**, yet leaving a small amount of clearance, as shown in FIG. **8**. Thus, when all of the tool bits and blades in the handle **42** or **44** are stowed within the respective cavity **70** or **72**, the rocker body **88** is held against the stop **100** with a small force originating from the latch spring **58**, and the latch release lever **84** and operating lever **86** are not free to rattle.

As shown in FIGS. **9**, **10**, **11**, **12**, **13**, and **14** various other latch releasing mechanisms could also be used in conjunction with the configuration of the handles **42** and **44**. The rims **62** and **64** define a convenient space to receive a latch release lever without taking up space in which folding blades can be stowed within a handle and moved to an extended position with respect to the handle.

In particular, as shown in FIG. **9**, a latch release lever **130** corresponds in function with the latch release lever **84** in the handle **42** or **44** and a main arm of the latch release lever **130** extends alongside an inner face of the sidewall **134**. Similar to the shoulder **82** on the latch release lever **84**, there is a

shoulder **132** on the latch release lever **130** that presses against the latch spring **58** to deflect it and disengage the catch **60** from the notch **106** of an extended tool blade such as the screwdriver **46** when the latch release lever **130** is pushed to the position shown in FIG. **10**.

A portion of the sidewall **134** of the tool handle **136** shown in FIGS. **9** and **10** defines an opening **138** extending from the outer margin of the sidewall **134** toward the back **140**, or channel base portion of the handle **136**. The opening **138** thus interrupts the rim **142**, corresponding to the rim **62**, providing a space through which a U-shaped portion **144** of the latch release lever **130** can move as it is rotated about a pivot axis **146** defined in this embodiment of the invention by the pivot pin **50**. It will be understood that the pivot axis **146** could be located elsewhere, although it is convenient to allow the latch release lever arm **130** to rotate about the pivot pin **50** as shown.

On the outside of the tool handle **136** a flat handle or grip portion depends from the U-shaped portion **144** and includes an outwardly facing grip surface **148**. The flat grip portion extends closely alongside the outer face **150** of the sidewall **134**. The bottom of the opening **138** encounters the U-shaped portion **144** as a stop to prevent the shoulder **132** from flexing the latch spring **58** beyond its elastic limit.

When the latch release lever **130** is not being utilize to unlatch an extended blade, the U-shaped portion **144** is aligned with the rim **142**, and a lower margin **152** of the flat grip portion rests alongside the outer face **150**, as shown in broken line in FIG. **10**. This keeps the latch release lever **130** mainly within space defined and protected by the rim **142**, so that contact of the upper side of the latch release lever arm **130** against the lower surface of the rim **142** keeps the U-shaped portion **144** from pivoting outward beyond a related position aligned with the margin of the sidewall **134**.

In another embodiment of the invention, as shown in FIGS. **11** and **12**, a tool handle **156** includes a latch release lever **158**, with a shoulder **159** engaging the latch spring **58**, similar in its operation to the latch release lever **130**. In the handle **156**, however, a sidewall **160** defines a slot **162** through which extends a portion of the latch release lever **158** including a hook **164** that extends alongside and parallel with an outer face **166** of the sidewall **160**. When the latch release lever **158** is in its relaxed, or inoperative position, not being used to release the catch **60** from the notch **106** of the blade **46**, the outer end or hook **164** is located slightly below the indented portion **68** of the rim **168**, with an upper surface of the latch release lever **158** engaging an inner surface of the slot **162**. The latch release lever **158** is similarly prevented from moving too far toward the spring **58** by encountering a bottom surface of the slot **162**.

The rim **168** corresponds with the rim **62** described previously, and also extends along the indented portion **68** of the sidewall **160**, as in the handles of the tool **40** described above. As in the handles **42** and **136**, the latch release lever **158** is mounted to rotate about the pivot pin **50**, and thus its axis of rotation **170** coincides with the central axis of the pivot pin **50**, although the latch release lever **158** could be attached to the handle **156** to rotate about a different axis of rotation if desired.

As shown in FIGS. **13** and **14**, in another embodiment of the invention, a handle **172** is also of generally channel-like form, and includes a sidewall **174** defining an opening **176** extending downward from its outer margin toward the back **178**. A rim **180**, similar to the rim **62**, extends along the outer margin of the sidewall **174** apart from the opening **176**.

A latch release lever **182** includes a shoulder **184** acting on the latch spring **58**, and is mounted for rotation about the pivot pin **50**, with an axis of rotation **186** of the latch release lever **182** coinciding with the central axis of the pivot pin **50**. The latch release lever **182** has a lower margin **188** that encounters the base or back **178** and prevents the latch release lever **182** from moving downward beyond the position shown in FIG. **14** and from flexing the latch spring **58** beyond its elastic limit.

The upper margin **190** of the free end of the latch release lever **182** engages the rim **180** to limit upward movement of the latch release lever **182** from the position shown in FIG. **14**, so that an outwardly directed rim **192** on the latch release lever **182** is aligned with the rim **180** of the sidewall **174** and provides a correspondingly rounded and comfortable shape to be encountered when the handle is gripped in using folding pliers or similar tools associated with a pair of handles such as the handle **172**. The rounded rim portion **192** also extends along an indentation **194** that provides convenient access to a nail nick in a folding tool bit or blade such as the screwdriver **46** located adjacent the sidewall **174** and the latch release lever **182**.

As may be seen best in FIG. **15**, the rims **64** may extend inward to overlap a knife blade **196** or a file **198**, requiring the knife **196** or file **198** to be pushed into the respective cavity **70** or **72** before being extended so that removal of one of the other blades or tool bits does not carry the knife **196** or file **198** along unnecessarily.

Handle Folding

In a preferred embodiment of one aspect of the present invention, a pair of pliers jaws **200** shown in FIGS. **15–17** include respective tangs **202**, **204** of the jaws, and each tang is attached to a respective one of the handles **42** and **44** by a respective pivot pin **206**. The pivot pins **206** are preferably fasteners similar to the pivot pins **50**, such as matingly threaded screws and tubular pins, and extend through corresponding holes defined in a pair of opposite flanges **208**, **210** in each of the handles **42**, **44**, located at a second, or jaw pivot end **212** of the tool **40**.

The two parts of each pivot pin **206** are tightened together and fixed with a suitable adhesive to hold the flanges **208**, **210** alongside each of the tangs **202**, **204**, but the pivot pins **206** are long enough for the flanges **208**, **210** to cause little or no frictional resistance to movement of each tang **202** or **204** with respect to the handle **42** or **44** to which it is attached.

In order to provide a controlled amount of friction resisting movement of the handles **42** and **44** with respect to the tangs **202** and **204**, a spring **216** is attached to the channel base **56** inside each of the handles **42**, **44** at the jaw pivot end **212**. A fastener such as a rivet **218** extends through corresponding apertures in a rear end or inner end **220** of the spring **216** and in the channel base or back **56** of each handle **42** and **44**.

An outer end **222** of each spring **216** rests upon a cam **224**, which may have a raised arcuate middle portion **226** and a cam lobe **227** leading to an end portion **228**. As shown in FIG. **16**, the end portions **228** are located at a smaller radial distance from the pivot pins **206** and are relatively flat. The outer ends **222** rest on the cam lobes **227** with a small clearance from the end portions **228** when the handles **42**, **44** are extended with respect to the jaws **200**. The outer ends **222** of the springs **216** rest on cam lobes **229** adjacent relatively low flattened portions **230** when the handles **42**, **44** are folded about the pair of jaws **200** as shown in FIG. **17**.

As may be seen in FIG. **18**, the spring **216** is a tapered, generally flat spring. Its outer end **222** is bent a few degrees away from the channel base **56** and out of alignment with the inner end **220**, and bears upon the tang **202** or **204**. The outer

end **222** is forked, defining a pair of prongs that have lateral surfaces **232** that face toward each other and are located alongside radial surfaces **234** of a centrally located raised portion or land **236** located alongside the cam **224** on each tang **202** and **204**, as shown in FIGS. **19–21**. The flat radial surfaces **234** cooperate with the lateral surfaces **232** to keep the outer end **222** of the spring **216** properly aligned with the tangs **202**, **204**.

It would also be possible to provide the flat radial surfaces on raised portions on opposite sides of the cam **224** on each of the tangs **202**, **204** and for the lateral surfaces **232** to be on opposite outer lateral sides of an outer end **222** of a spring **216**, which then need not be in the form of a fork.

When the handles **42**, **44** are being folded or unfolded with respect to the tangs **202**, **204** of the pliers jaws **200**, the outer end **222** of the spring **216** rides upon and is elastically biased toward the arcuate surface **226**, providing some friction to prevent the handles **42**, **44** from moving too easily with respect to the jaws. As the handles **42**, **44** approach the fully extended position shown in FIG. **16**, the outer ends **222** ride onto the cam lobes **227** and extend toward the flat end portions **228** to urge the handles **42**, **44** toward the fully extended position shown in FIG. **16**. Similarly, the outer ends **222** ride onto cam lobes **229**, providing a small clearance from the flat portions **230** on the opposite side of each tang **202**, **204** when the handles **42**, **44** approach the fully folded position shown in FIGS. **17** and **21**, and by spring force against the cam lobes **229**, the springs **216** then urge the handles **42**, **44** toward the folded configuration with respect to the tangs **202** and **204** as shown in FIGS. **1** and **17**.

When the tool is in the configuration shown in FIG. **16**, for use of the pliers jaws **200**, an end stop or abutment surface **238** of the channel base **56** or back portion of each handle **42** or **44** rests against a shoulder **240** defined on the confronting side of each of the tangs **202**, **204**. Consequently, squeezing forces exerted on the handles **42**, **44** to close the pliers jaws **200** toward each other are carried through the end stop or abutment surfaces **238** and shoulders **240**, and not by the springs **216**, so that the rivet **218** needs only enough strength to retain the spring **216** attached to the channel base portion **56** against the elastic force of the spring **216**.

While the force of the outer end **222** of the spring **216** against the cam lobe **227** tends to keep the handles extended with respect to the tangs **202**, **204**, a raised retention bump or interfering body **242** is also provided on the central land **236**, close to the shoulder **240**, to press against the inner surface of the channel base **56** when the handles **42**, **44** are in or nearly in the fully opened configuration shown in FIG. **16**. Pressure of the retention bumps **242** against the channel bases **56** provides additional frictional resistance against folding of the handles **42**, **44** with respect to the pliers jaws **200**. Such resistance is useful, for example, when using wire-cutter portions of the pliers jaws. With the spring **216** acting on the spring cam **224**, it is unnecessary to provide interference between the central land **236** and the inner surface of the channel base **56**, except when the handles **42**, **44** are intended to be more securely held in the open position shown in FIGS. **1A** and **16**. Nevertheless, there is ample friction provided by the spring **216** to prevent the handles from flopping freely about the tangs **202**, **204** of the pliers jaws **200**. As a result, it is unnecessary to provide tension in the pivot pin **206** to hold the flanges **208**, **210** tightly against the tangs **202**, **204**, and it is unnecessary to manufacture the tangs **202**, **204** with tolerances as demanding as is necessary when the central land **236** or a corresponding surface is required to provide friction against the inside surface of the channel base **56** throughout the entire range of motion of the handles **42**, **44** with respect to the pliers jaws **200**.

Folding Scissors

As shown in FIGS. **22** and **23**, a pair of folding scissors **250** included in the folding multipurpose tool **40** is latched in its operational configuration, extending from the tool blade end **48** of the handle **42**. The folding scissors **250** may be made of sheet steel and include a first scissors leg **252**, whose base portion **254** is mounted on the pivot pin **50** for rotation between the extended operational position shown in FIG. **22** and a stowed position within the cavity **70** defined between the sidewalls **52** and **54** of the handle **42**. A fixed blade portion **256** extends outward from the base portion **254** beyond a blade pivot joint **258** preferably including a rivet extending through corresponding bores in the first scissors leg **252** and a second scissors leg **260** to interconnect the two scissors legs with each other.

The second scissors leg **260** includes a moving blade portion **262** and a handle **264** extending oppositely away from the blade pivot joint **258**. A thumb tab **266** extends laterally from an outer end of the handle portion **264** to contribute to comfortable operation of the scissors **250**. It may be formed by bending a sheet metal blank from which the second scissors leg **260** is made and, preferably, has an arcuately curved margin to be comfortably pressed.

Each of the blade portions **256** and **262** has a sharp, generally straight smooth edge portion **268**, which could be curved, if desired, and which can be used to cut easily through paper with a pushing movement and little movement of those edge portions **268** relative to each other. Additionally, sharpened serrations **270** are provided on each of the blades **256**, **262** near the outer end or tip of each blade. The serrations **270** may be in the form of narrow, round-bottomed, grooves inclined with respect to the blades, or in the form of continuously wavy or sinuous curves, and may have a depth of 0.003 inch and a radius of curvature of 0.015 inch, for example. The serrations **270** may be spaced apart at a pitch of 0.023 inch, in a preferred embodiment, although variations of these dimensions on the order of a few thousandths of an inch will also be serviceable. Serrations **270** may be provided on either one or both of the blade portions **256** and **262**, and the serrations on each blade may be aligned with or staggered with respect to serrations on the opposite blade. Provision of the serrations **270** improves the ability to use the folding scissors **250** to cut materials including small strong fibers, as the serrations **270** can resist a tendency of materials being cut to be squeezed outward from between the tips of the blades **256** and **262**.

The first scissors leg **252** is held in its extended position with respect to the handle **42** by the engagement of the catch **60** in a notch **272**, corresponding with the notch **106** in the base of the folding screwdriver **46** described previously. Alternatively, an outer end of a flat spring (not shown), similar to the spring **58** without the catch **60**, could rest on a cam lobe **273** shown in FIG. **26** to hold the first scissors leg **252** in the position shown in FIG. **22**.

Pressure on the tab **266** toward the handle **42**, when the first scissors leg is in its extended position, pivots the moving blade portion **262** alongside the fixed blade portion **256** for a cutting stroke. In order to reopen the scissors blades from each other after each cutting stroke, a slender finger-like spring **274**, which may be of sheet steel cut to the appropriate shape, extends away from the handle **42** alongside the base portion **254**. The spring **274**, or at least its base **280**, is preferably slightly thicker than the second scissors leg **260** to give clearance for movement of the second scissors leg **260** between other blades or tool bits associated

with the handle **42**. The spring **274** has a tip **276** or outer end that rests against a back surface **278** of the handle **264** when the scissors blades portions **256** and **262** are in a cutting relationship with each other, as with the pair of scissors **250** in the operational configuration shown in FIG. **22**.

As shown more clearly in FIG. **23**, the spring **274** has a base **280** located alongside the base portion **254** of the first scissors leg **252**. A spring pivot includes a protruding portion such as a spring pivot pin **283** fixed in the base **280** and extending rotatably into a hole of a corresponding size defined in the base **254** of the first scissors leg **252** a small distance form the notch **272** and spaced radially outward from the pivot pin **50** by a small distance **287**, such as about 0.07 inch. The base **280** includes a notch **282** that is aligned with but wider than the notch **272** in the base portion **254** of the first scissors leg **252**, so that the base **280** of the spring **274** is free of the catch **60** to rotate through a small angle about the spring pivot when the folding scissors **250** are in the extended position shown in FIG. **22**. The base **280** is carried along with the base **254** when the first scissors leg **252** rotates about the pivot pin **50**, when the catch **60** is not engaged in the notch **272** in the base portion **254** of the first scissors leg **252**. Movement of the base **280** of the spring **274** about the spring pivot is limited to an angle of several degrees, for example, 8°, with respect to the base portion **254**, by engagement of a limiting structure such as a pin **284** protruding within an opening such as the hole **286** defined in the base portion **254**. The spring pivot pin **283** and the pin **284** may be separate pieces fixedly fitted in corresponding holes defined in the base **280** of the spring **274**, or, preferably, the spring pivot pin **283** and the pin **284** may be produced by coining or semi-piercing the base **280** using suitable punch and die combinations.

The pin **284** is located at a front end of a leg **288** of the base **280** extending generally parallel with a leg **289** of the spring **274**. The spring **274** extends rearwardly from the pin **284** and has a curved, or U-shaped portion **291** that is located alongside the base **254** of the first leg **252**, and then extends forward along the first scissors leg **252**. The generally U-shaped portion **291** extends around the pivot pin **50** but is always clear of it by at least a small distance so that the spring **274**, except for the base **280**, is free to flex along its entire length and with respect to the base **280** during use of the scissors **250** in response to pressure exerted by the back surface **278** of the handle **264**.

Thus, in use of the scissors **250**, when the thumb tab **266** is pressed toward the handle **42**, the spring **274** urges the base **280** to rotate counterclockwise about the spring pivot pin **283** as seen in FIG. **23** until the pin **284** engages the interior surface of the hole **286**. Further movement of the handle **264** in a clockwise, blade closing direction about the blade pivot joint **258** causes the spring **274** to flex elastically. By reaction, the spring **274** urges the handle **264** in the opposite direction to reopen the moving blade **262** away from the fixed blade portion **256** when pressure on the thumb tab **266** is relaxed. Rotation of the handle **264** with respect to the base portion **254** of the first scissors leg **252** is limited by the leg **288**, which blocks the back surface **278** once the edges **268** have closed alongside each other, and thus prevents further movement of the moving blade **262** toward or past the fixed blade portion **256**.

When it is desired to stow the scissors **250** in the handle **42** the blade latch release mechanism is operated as described previously to remove the catch **60** from the notches **272** and **282**, allowing the base portion **254** of the first scissors leg **252** to be rotated about the pivot pin **50** toward the position shown in FIG. **24**, carrying the second scissors leg **260** and the spring **274** along with it. The second scissors leg **260** is also rotated counterclockwise as shown in FIG. **23** about the blade pivot joint **258**, toward the position shown in FIG. **25**, in which the moving blade **262** extends along the base portion **254** of the first scissors leg **252**, opposite the direction of the fixed blade portion **256**, so that the edges **268** extend substantially oppositely away from the blade pivot joint **258**. In order for there to be room for the moving blade **262** to extend alongside the base portion **254**, the spring **274** and its base **280** rotate clockwise about the spring pivot with respect to the base portion **254** of the first scissors leg **252**, until the pin **284** reaches the position in the hole **286** shown in FIG. **25**. Further movement of the folding scissors **250** relative to the handle **42** counterclockwise from the position shown in FIG. **25**, as by pushing against the base portion **254** and the handle **264**, takes the folding scissors **250** the remaining distance into the cavity **70**, to the stowed position shown in FIG. **26**, in which the spring **274** is free of contact with the back surface **294**. Nevertheless, there is room for the spring **274** to rotate counterclockwise slightly with respect to the base portion **254** of the first scissors leg **252** and come into contact with the back surface **294**, as a result of the freedom of the pin **284** to move within the hole **286**. When the folding scissors **250** are stowed within the cavity **70** the thumb tab **266** lies against the interior surface of the channel base portion **56** leaving room for the jaws **200** of the pliers to be folded into the cavity.

The scissors **250** can be unfolded from the stowed position to prepare them for use by engaging the hook **290** in the base portion **254** of the first scissors leg **252** to rotate it up a small distance from the base portion **56** of the handle **42**, about the pivot pin **50**, until the peripheral surface **293** of the base portion **254** encounters the catch **60**. As the first scissors leg **252** reaches the position shown in FIG. **25**, a peripheral, or outer surface **292** of the U-shaped portion **291** of the spring **274** also encounters the catch **60**, which urges the spring **274** to pivot about the pivot pin in a clockwise direction with respect to the base **254** of the first scissors leg **252**, until the pivot pin **283** moves past the catch **60**. This keeps the tip **276** of the spring **274** clear of a back surface **294** of the moving blade **262** as the scissors are moved toward the operational configuration shown in FIGS. **22** and **23**. Finally, once the first scissors leg **252** is fully extended and latched with respect to the handle **42**, the second scissors leg **260** is manually moved clockwise about the blade pivot joint **258**, bringing the handle **264** toward the base portion **254** of the first scissors leg **252**. This makes the scissors ready for use.

In order to distribute the pressure of the catch **60** sufficiently to resist undesirable wear on the peripheral, or outer surface **293** of the base portion **254** of the first scissors leg **252**, the shape of the outer base surface **292** corresponds closely with the arcuate peripheral surface **293** of the base portion **254**, except for the difference between the notch **282** and the notch **272**.

Container Opener

One of the folding tool bits of the folding multipurpose tool **40**, as shown in FIG. **22**, is a combined can opener and bottle opener **300** mounted at the blade pivot end **48** of the handle **44**, where its base **302** is mounted on the pivot pin **50**, for rotation between a stowed position within the cavity **72** and an extended position, in which the catch **60** on the latch spring **58** of the handle **44** engages a notch **106**, as shown in FIGS. **27** and **28**. A bore **304** which fits about the pivot pin **50** defines a pivot axis **306** that coincides with the central axis of the pivot pin **50**.

The container opener **300** has a generally planar body **308** with opposite sides defining opposite side planes, a right side

plane **310** and a left side plane **312**, as viewed when using the opener **300**. A generally flat back surface **314** is perpendicular to the side planes **310** and **312** and defines a reference plane. Although the back surface **314** need not be precisely planar it does, nevertheless, define generally the location of the reference plane extending perpendicular between the side planes **310** and **312**. A nose portion **316** has a front end **318** and is directed forward at a downward angle **319** from the back surface **314** and the corresponding reference plane.

A hook **320** has a tip **322** located in or adjacent the side plane **310**. The tip **322** is directed forwardly, generally in line with a bottom margin **324** of the body **308**. A surface **323** extends diagonally rearward from the tip **322** toward the right side plane **312**, and is seen clearly in FIG. **28**. The tip **322** is thus pointed and able to engage a rim of a crown cap easily. A surface **325** parallel with the left side plane **310** is recessed laterally from the side plane **310** and defines a throat space between the tip **322** of the hook **320** and a more rearwardly located portion of the body **308**. A rearward surface of the tip portion **322** extends transversely with respect the body **308** and is generally vertical and thus approximately perpendicular to the side plane **310** and the reference plane corresponding to the back surface **314**. A sharp edge **326** lies substantially in the side plane **310**, aligned with the tip **322**, and is defined by a beveled or diagonally extending surface **328** extending obliquely forward from the edge **326** toward the side plane **312**. The tip **322** may be spaced rearwardly from the front end **318** by a distance **329** of 0.72 inch in a preferred embodiment of the invention.

The shape of the tip **322** and the location of the throat space enable the tip **322** to extend to the left to be hooked beneath the crimped rim of a "tin" can or similar container whose top is to be removed using the opener **300** so that the rim extends into the throat space while the edge **326** cuts the top of the can. This configuration also enables the opener **300** to have a conveniently small depth **327** of 0.5 inch or less between the back **314** and the bottom **324**, to avoid needing excessive space for stowage in the cavity **72** or in another tool handle.

A groove or nail nick **330** may be provided to facilitate raising the opener **300** from a stowage position within the handle **44** to extend it to the position shown in FIG. **22**.

A wire stripper **332** in the form of a beveled notch is provided along the bottom **324** and includes a sharpened edge **334**.

The opener **300** may be machined from a suitable steel blank, or may be manufactured by metal injection molding and sintering methods, if desired.

As shown in FIGS. **29**, **30**, and **31**, a somewhat similar opener **340** may be manufactured by laminating to one another a pair of layers which may be fine blanked and coined or semi-pierced. A first layer **342**, which is the left side when the opener is in use, includes a nose portion **344** on a body **346**. A forward lower margin portion **348** of the body **346** faces diagonally downward and forward. A second layer **350**, which is the right side when the opener is in use, is located closely alongside the first side layer **342**, and the two layers **342** and **350** are aligned with each other by pin-like projections **352** and a bar-like projection **354** on the second side layer **350** which extend into corresponding apertures **356** and **358** defined in the first side layer **342**. The projections **352** and **354** may be produced by semi-piercing the second side layer **350** while the openings **356** and **358** may be provided by fine blanking procedures.

At the bottom of the second side layer **350** is a hook **360** extending forward from the body portion **346** of the opener. The hook **360** is bent at an angle of about 15°, for example, to project forward diagonally into the space beneath the first layer **342**, ahead of the lower margin **348**. The hook **360** and the lower margin **348** cooperatively define a throat space **362** behind the tip of the hook **360**, so that the tip of the hook **360** can engage the bottom of the crimped rim of a "tin" can with the rim extending into the throat **362** as the nose portion **344** of the opener **340** is used to pierce and cut away the top member of the container. Since the first side layer **342** has a thickness of only 0.050 inch and has sharp corner edges **364** as a result of being cut from a sheet of steel stock, it performs effectively, if not particularly efficiently, in cutting away the lid of a "tin" can.

A wire stripper **366**, similar to the wire stripper **332**, may be provided in the lower margin of the left side layer **342**.

It will be understood that the openers **300** and **340** could also be made as mirror opposites of the openers described.

Interlocking Blades

In order to stabilize the handles **42**, **44** with respect to each other during use of one of the folding blades of the multi-purpose folding tool, an interlock portion **370** may be provided on one of the tool bits such as a straight screwdriver **372** stowed within the handle **42**, while a mating interlock portion **374** is provided on another folding tool bit such as a cruciform screwdriver **376** stowed within the handle **44** in a position opposite the screwdriver **372**. As may be seen in FIGS. **17** and **32**, the interlock portions **370** and **374** include respective sloping, inclined surfaces that fit against each other, while face surfaces **378** and **380** that are extensions of the sides of the screwdrivers **372** and **376** extend alongside other tool blades or bits stowed within the opposite handles, so that the relationship between the interlock portions **370** and **374** resists lateral movement of the handles **42** and **44** in respect to each other during use of one of the tool blades or bits stowed ordinarily in either of the handles **42** and **44**. Since the interlocks **370** and **374** protrude only a small distance above an imaginary plane defined generally by the rims **62**, **64** and the generally coplanar back surfaces of the blades and tools stowed in each of the handles **42** and **44**, the interlocks **370** and **374** do not detract noticeably from comfort during use of the pliers jaws **200**. They do, however, provide hooks to be engaged by one's fingernail to open a blade or tool bit from its position of storage within a respective one of the handles of a multi-purpose tool so that tool bits or blades stowed between other tool bits can be opened easily from the handle in which they are stowed.

It will be understood, as may be seen in FIG. **33**, that an additional pair of interlocks **370'** and **374'** may be provided on another pair of oppositely located tool blades in the handles **42** and **44**, so that two pairs of interlocks are available to keep the handles **42** and **44** aligned with each other during use of a selected tool bit or blade including one of the interlocks.

As may be seen with reference to FIGS. **34**, **35**, **36**, **37**, and **38**, not only may such interlocks be in the form of portions **370** and **374** with inclined mating surfaces and defining hooks, but a respective portion of each tool blade may be machined to a reduced thickness, leaving interlocking flat portions **382** and **384** of reduced thickness able to interlockingly overlap one another as shown in FIGS. **35** and **36**. Such overlapping interlocking portions **382** and **384** may each include an almond-shaped opening **385** serving as a nail nick extending through the interlock portion, or overlapping portions **386** and **388** as shown in FIGS. **37** and **38**, may be shaped to present a hook to be engaged by one's fingernail to open a particular blade or tool bit from position between other blades or tool bits.

Blade Latch Security Referring next to FIGS. **4**, **39**, and **40**, a flat surface **400**, between the cam lobe **116** and the inner face **110** of the notch **106**, in a base **114** of a folding blade or tool bit such as the screwdriver **46**, rather than being precisely parallel with the channel base or back surface **56**, is inclined outwardly, away from the pivot axis **112** seen in FIG. **4**, by an angle **402** which is slightly smaller than the angle **404** by which the inner surface **403** of the latch spring **58** diverges outward from the plane **405** defined by the channel base **56** as a result of deflection of the latch spring **58** by the cam lobe **116**. The outwardly inclined orientation of the flat surface **400** relative to a surface parallel with the plane **405** of the channel base **56** gives the notch **106** a slightly, but significantly, deeper surface **110** located opposite the inner face of or in contact with the catch **60** when the inner surface of the latch spring **58** rests on the cam lobe **116**. Where the angle **402** is 2°, sloping the flat surface **400** closer to the orientation of the spring **58**, while still maintaining an angular divergence of about 1° of arc, gives a depth of engagement of about 0.003 inch, or 6% greater than when the flat surface **400** is parallel with the plane **405**. Pressure of the latch spring **58** against the cam lobe **116** still urges the blade, for example, the screwdriver **46**, in a counterclockwise direction until the outer face of the catch **60** encounters the shoulder **108** of the blade, as shown in enlarged view in FIG. **39**.

Preferably, the notch **106** has a depth **406** beneath the flat surface **400** that is great enough to permit manufacture by use of a blanking die with a radius large enough to have ample strength. This depth **406** will be greater than the depth **408** of the catch **60**, which is limited by the ability of the latch spring **58** to flex far enough for the catch **60** to be removed from the notch **106** without exceeding the elastic limit of the latch spring **58**.

As shown in FIG. **40**, in a multipurpose tool in which the latch spring **58'** includes no catch corresponding with the catch **60**, the flat surface **400** is inclined outward at an angle **402** with respect to the plane **405** defined by the base portion **56**. The flat surface **400** thus diverges slightly, preferably by about 1°, from the orientation of the inner surface of the deflected latch spring **58'** that bears on the base **114** of the blade. As a result, the spring **58'** presses against the cam lobe **116** and urges the blade in a counterclockwise direction as seen in FIG. **4**, keeping the shoulder **108** engaged against the outer end **410** of the latch spring **58'**, as shown in FIG. **40**.

Alternative Handle Configuration

The present invention may also be embodied in a folding multipurpose tool including a handle **412**, shown in FIGS. **41–48**. Such a tool might be similar to the tool **40** described above and shown in FIG. **1**, but would incorporate the handle **412** in place of the handle **44**, and a similar, mirror-image handle could be substituted also for the handle **42** of the tool **40** shown in FIG. **1**.

The handle **412** has generally the form of an elongate channel with a pair of opposite ends, a blade pivot end **414**, and a tool jaw end **416**.

Folding blades (not shown) such as the straight screwdriver blade **46** and other screwdriver blades, knife blades, files, and folding scissors may be mounted in the same fashion as in the folding tool **40** at the tool blade end **414** of the handle **412**, arranged to pivot about an axis defined by a pivot pin **418** similar to the pivot pin **50** described above. For the sake of simplicity, while the heads of the pivot pin **418** are shown in FIGS. **41**, **44**, **47**, and **48**, the pivot pin **418** is omitted from FIGS. **42**, **43**, **45**, and **46**.

The handle **412** is of sheet metal blanked and pressed into the form shown, in which a main channel includes a channel base **420** and a pair of sidewalls **422** and **424**. The sidewall **422** is connected with the channel base **420** in a smoothly curved bend providing a rounded corner for a comfortable grip. A latch spring **426** extends from the channel base **420** and carries a catch **428**.

A latch release mechanism similar to that provided in the tool **40** may be associated with the handle **412**, as is shown by the inclusion of a latch release operating lever **430** attached to the sidewall **422** by a fastener such as a rivet **432**. The operating lever **430** projects outwardly through an opening **434** defined in the channel base **420** and outer sidewall **422**, as seen best in FIGS. **41** and **42**.

An inwardly directed rim **436** extends along a margin of the sidewall **422** from the tool blade end **414** toward the jaw pivot end **416**, following the contour of the margin of the sidewall **422**, including a nail nick access indentation **438**. The rim **436** merges with the outer sidewall **422** giving a smoothly rounded surface and additional area to be gripped and squeezed, as described above with respect to the rims **62** and **64**.

A hole **440** is provided in the channel base portion **420** of the handle **412** to receive a fastener to attach a spring such as the spring **216** shown in FIG. **15**, to act on a tang of a tool such as a pliers jaw.

As in the handle **44** shown in FIG. **15**, the sidewalls **422** and **424** include a pair of flanges **442** and **444** at the jaw pivot end **416** of the handle **412**, and the flanges **442**, **444** define respective openings **446** and **448** to receive a jaw pivot pin **449** shown partially cutaway in FIG. **44**. The channel base **420** includes an end surface **450** corresponding with the end surface **238** described above in connection with the tool handle **44**.

Interconnected with the sidewall **424** is a side wing portion **452** that initially extends away from the sidewall **424**, curving arcuately as shown at **454**, and then extends flat and approximately parallel with the sidewall **424**, to define a side trough **456** facing in a direction opposite that of the main channel defined between the sidewalls **422** and **424**. This aspect of the handle **412** is similar to a portion of the tool described in copending U.S. patent application Ser. No. 08/961,055, of which the disclosure is hereby incorporated herein.

The sidewall **424** is cut to define a blade locking member **458**, bent with respect to the sidewall **424** to project at a small angle into the side trough **456**, in position for its front surface **459** to engage the base of a folding outer blade **460** shown in its extended position in FIG. **48**. A large radially extending axial bearing **461** mounted on the jaw pivot pin **449** keeps the blade **460** attached to the handle **412**, supporting it and allowing it to pivot between a folded position shown in FIG. **47** and the extended position shown in FIG. **48**. A small detent bump **462** is provided on the blade locking member **458**, and an upper surface of the blade locking member **458** defines a notch **464** to receive a projecting member (not shown) associated with the folding outer blade **460**, to establish properly the folded position of the outer blade **460**, shown in FIG. **47**.

A front margin portion **466** of the side wing portion **452** is arcuately curved so as to provide access to push the blade locking member **458**. A portion **468** of the margin of the side wing portion **452** is shaped to provide access to a nail nick **470** in the tip of the folding outer blade **460** in order to begin moving it from its folded position in which it is held by interaction of the detent bump **462** with a corresponding dimple (not shown) in the folding outer blade **460**.

A bolster **472** is mounted on the handle **412** at the blade pivot end **414**, closing the end of the side trough **456** and presenting a smoothly rounded surface having a desirable appearance.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

What is claimed is:

1. A folding scissors, comprising:

(a) a handle defining a cavity;

(b) a first pivot pin interconnected with said handle;

(c) a first scissors leg having a base attached to and moveable about said first pivot pin with respect to said handle, between a stowed position in said cavity and a deployed position, said first scissors leg having a fixed blade portion extending from said base thereof;

(d) a second scissors leg interconnected with said first scissors leg by a blade pivot joint, said second scissors leg including a moving blade portion and a handle portion located opposite each other with respect to said blade pivot joint, and said handle portion of said second scissors leg having a back surface; and

(e) a finger-like spring extending alongside said base of said first scissors leg, said spring having a base portion located alongside said base of said first scissors leg and interconnected therewith by a spring pivot spaced apart from said first pivot pin, said spring being movable with respect to said first scissors leg about said spring pivot, said spring also having an outer end resting on said back surface of said handle portion of said second scissors leg when said blade portions are in a cutting relationship, whereby said back surface of said handle portion of said second scissors leg moves said outer end and thereby causes said spring to flex elastically as said scissors legs are moved about said blade pivot in a blade closing direction.

2. The folding scissors of claim **1** wherein said second scissors leg is moveable with respect to said first scissors leg about said blade pivot joint in a blade opening direction to a stowage configuration in which said blade portions extend oppositely away from each other, said back surface of said handle portion being spaced apart from said outer end when said folding scissors are in said stowage configuration.

3. The folding scissors of claim **2** wherein said base portion of said spring is movable about said spring pivot with respect to said base of said first scissors leg only within a predetermined angle, between a first position occupied when said blade portions are in said cutting relationship and a second position occupied when said scissors are in said stowage configuration, said moving blade of said second scissors leg lying alongside said base of said first scissors leg, and said back surface of said moving blade portion of said second scissors leg being free from contact with said spring when said base portion of said spring is in said second position.

4. The folding scissors of claim **1** wherein a portion of said spring extends around said first pivot pin and is spaced apart from said first pivot pin, thereby being free to flex without coming into contact against said pivot pin.

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